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Part I.—Original Articles.

THE EFFECTS OF INTRAVENOUS INSULIN IN SAKEL'S HYPO-GLYCAEMIC TREATMENT.

By A. M. SPENCER, M.B., B.S., B.Sc., D.P.M.,

Deputy Medical Superintendent, Joint Counties Mental Hospital, Carmarthen.

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THE use of intravenous insulin in Sakel's shock treatment as an alternative to intramuscular insulin was first reported by Ventriglia (1939), whose findings may be summarized as follows :

(1) Hypoglycaemic symptoms appear more quickly than with intramuscular insulin, so that the pre-shock period is shortened.

(2) The coma dose of insulin is reduced by 50 per cent. on an average, but may be reduced by considerably more.

(3) In some cases the hypoglycaemic symptoms are more abrupt and violent.

(4) There is a greater tendency to tonic-clonic spasms and convulsions generally.

Ventriglia's experience led him to prefer intravenous insulin to intramuscular, but apart from the saving of the insulin, he gives no reasons for this decision. No definition is given, either, of the standard of coma adopted. This is unfortunate, since the standard of coma adopted by different workers varies considerably and makes comparison of their results very difficult.

In the same year Bardenat and Leonardon (1939) administered insulin intravenously in an attempt to overcome the resistance to insulin not infrequently found in Sakel's usual treatment. They found that the pre-coma stage was shortened by about two-thirds, and that pre-coma excitement was almost entirely abolished, but their work did not enable them adequately to compare the results of the two methods of administration.

The next paper on the subject to appear was that of McGregor and Sandison (1940), who used intravenous insulin as a possible means of economizing its

use during wartime. They found that the intravenous "coma-dose" varied from 25 per cent. to 75 per cent. of the intramuscular coma-dose, the average for 8 patients being 53.4 per cent. This result is, therefore, in agreement with that of Ventriglia. Unfortunately, it is not possible to assess the validity of the authors' conclusions, as they do not mention (a) their standard of coma or (b) the exact circumstances under which the comas they refer to were induced. This latter point is an important one, for no patient has a constant "coma-dose." Once coma has been induced it is usually possible to induce it with progressively smaller doses on following days owing to the patient becoming sensitive to the insulin. Corwin (1939) pointed out this and it would be insufficient to determine a given patient's coma-dose with intramuscular insulin and then immediately switch over to intravenous insulin. On such a procedure the intravenous dose would almost certainly be less than the intramuscular one, but only because the decreased resistance to hypoglycaemia induced by the intramuscular insulin had been ignored.

It is very difficult to obtain standardized conditions for a comparison between the effects of intramuscular and intravenous insulin, as it is almost impossible to keep such factors as the body weight of the patients constant during the experiments. The method adopted in the experimental portion of this study would appear to be as valid as possible under the circumstances. By this method the *intramuscular* coma-dose of alternate patients was first ascertained and then the patients were "rested" for 14 days before their intravenous coma-dose was determined. The remaining patients were then taken and their *intravenous* coma-dose found, followed by 14 days' rest, after which their intramuscular coma-dose was ascertained.

A few weeks after the publication of the above paper Maxwell Jones (1940) published his findings in a series of seven cases. Unlike Ventriglia and McGregor and Sandison, this author found that the coma-dose was the *same* for intramuscular and intravenous insulin, but that the time before the onset of coma was shortened by an average of 45 minutes. Jones states that a patient was judged to be in a coma "when there was no voluntary response to external stimuli, extensor plantar response was present and the corneal reflex absent." This is the standard adopted in the present work and must be considerably "deeper" than McGregor and Sandison's standard, as they allowed their patients to remain in coma for $1\frac{1}{2}$ –2 hours, a procedure which would have resulted in a high proportion of prolonged comas had Jones's standard been followed.

In the same year Polatin, Spotnitz and Wiesel (1940a and 1940b), unaware of Ventriglia's work, used intravenous insulin in the treatment of mental disorder. They endeavoured to determine "whether hypoglycaemic shock itself, without prolonged coma, might be of benefit in the treatment of patients with mental disorder." The dose used varied between 27–90 units and no attempt was made to induce coma. It was found that no convulsions occurred and that spontaneous recovery was the rule. This, however, would probably have been the result had these comparatively small doses been used intramuscularly. The authors note one interesting point, that a biphasic or delayed reaction may occur with intravenous as with intramuscular insulin.

"These biphasic effects were also repeatedly seen after the injection of insulin intravenously. One patient, about one and a half hours after injection, was alert and drank dextrose, only to slip back within five minutes into a state of coma deeper than the primary reaction. About 30 minutes later she again recovered spontaneously." This suggests that as far as one of the complications of intramuscular insulin—the delayed reaction—is concerned, intravenous insulin has no advantage.

Horvath and Friedman (1941) gave up to 500 units of insulin intravenously, but their purpose was to observe the effect upon the blood sugar and blood lactate. Contrary to Damashek *et al.* (1935), who found that the intravenous injection of 8–80 units intravenously caused a definite increase in the blood lactic acid, these authors found that insulin did not affect the blood lactate except in resistant cases. They also noted that "the response to intravenous insulin was similar to that of intramuscular insulin, no ill effects were observed. The coma produced by intravenous insulin is, in general, much quieter than that induced by intramuscular insulin. Recovery was, in many cases, spontaneous after two hours and no recurrences of coma or convulsions were observed." A number of anomalous results were encountered. In one patient 20 units of insulin were as efficacious in lowering and keeping the blood sugar down, as were 100 or 160 units, and in another patient 160 units failed to lower the blood sugar to the same extent as 50 units had done previously.

Sherman, Mergener and Low (1941) observed the effects of intravenous and intramuscular insulin in 13 patients. Their method was to divide the cases into two sets. To the first set insulin was given subcutaneously in increasing doses until coma was reached and then "the dose was gradually diminished until coma was produced within a fairly constant time with what appeared to be a minimal dose." The patient was maintained on this dose for about 5–10 days, after which blood-sugar studies were made. Then the insulin was given intravenously and the dose increased or decreased, depending on whether coma was produced. The dose by this second method of administration was stabilized and blood-sugar studies made again. To the second set of patients the insulin was first given intravenously and, following the same procedure, was later replaced by subcutaneous insulin. This method of comparison is open to only one objection. It ignores the usual trend of a patient's coma-dose, which, following the initial reduction owing to "sensitization," usually increases as the treatment proceeds, and the second method of administration may have been adopted just when the patient would be requiring these larger coma-doses in any case. It would have been preferable to have found the sensitized coma-dose by either route and then, following an adequate rest period, to have started *de novo* with the alternative mode of administration and found the patient's sensitized coma-dose by that route.

The authors found that in every case the precoma time was shortened from a minimum of 24 minutes to a maximum of 90 minutes. As regards the coma-dose, 6 patients required the same by either route, 3 required more by the intravenous route and 2 required less by this route than subcutaneously. They conclude "that there is no appreciable difference in the coma-doses required between intravenous and subcutaneous insulin." They also found

that there was no significant difference in the incidence of complications and that spontaneous emergence from intravenously induced coma was rare.

Mention should be made of the authors' standard of coma, which was apparently a light one. "The patient was called loudly three times; if there were no verbal or facial response, he was pricked three times around the upper lips and nostrils. Failure to respond by some facial grimace or other protective movement suggested the presence of coma." This standard of coma is, of course, much lighter than that of Jones (1940).

In 1942 Sandison and McGregor amplified their results reviewed above on the basis of a year's experience with intravenous insulin. Their earlier work was confirmed, except that in the additional 24 patients treated the intravenous dose required to produce coma was 71·7 per cent. of the intramuscular dose compared with 53·4 per cent. in the earlier series. A number of the points raised in this paper will be discussed later, when the mode of action of intravenous insulin is discussed, but attention may be drawn to the method used of determining the coma dose for intravenous insulin. The patients apparently were first given intramuscular insulin until coma was induced. On the following days intravenous insulin was given, until the most satisfactory coma dose was found. As would have been expected, the intravenous coma dose was invariably the lower. Such a method of comparison is unsatisfactory as the patient would be developing sensitivity to insulin when on intramuscular insulin, the effect of which would be to lower the coma dose of intravenous insulin, since this followed immediately after the intramuscular doses. As mentioned earlier, the only adequate method of comparison is to find a patient's coma dose on intramuscular insulin, give seven to fourteen days' rest and then find the coma dose in intravenous insulin and compare the two. Even with this method, the results can only be approximate unless extreme care is taken to provide a diet with a constant carbohydrate content for the whole period of the experiment, since, as Himsworth (1939) has shown, sensitivity to insulin is directly proportionate to the absolute amount of carbohydrate in the diet.

In this paper Sandison and McGregor also refer to their definition of coma. It has already been pointed out that several workers on intravenous insulin have not specified the exact stage of unconsciousness which they designate as coma. Some authors regard a patient as being in coma as soon as he becomes unconscious. Sherman *et al.* (1941). Others, e.g. James, Freudenberg and Cannon (1938) state that coma is present when the patient is unconscious and the plantar responses are extensor. Still others, e.g. Maxwell Jones (1940), Mahoney and Herskovitz (1942) following Wilson (1937) adopt as criteria of coma, unconsciousness, a positive Babinski and absent corneal reflexes. The point is of considerable importance, as absence of the corneal reflex indicates a much "deeper" state of hypoglycaemia than does the presence of unconsciousness with a Babinski response and it is possible that the more quickly acting intravenous insulin might be able to produce the latter sooner than the more slowly acting intramuscular insulin, but that its action might not be sufficiently prolonged to induce the deeper state indicated by absent corneal reflexes. The conflicting reports which have already been noticed as to the

relative amounts of intravenous and intramuscular insulin required to induce coma may, therefore, possibly be accounted for by the different standards of coma adopted.

Sandison and McGregor (1942) state that "in all our work we have defined insulin coma according to Sakel's original description, that it to say, a condition in which the patient's normal responses to stimuli are lost. There is sweating, flushing of the skin and usually profuse salivation; the reflexes are all lost excepting the corneal reflex and the plantar response is extensor." In view of the importance of the definition of coma, Sakel's own description may be quoted. In the original German text (Sakel, 1935*a*) the following passage occurs (p. 9): "Diese können entweder mit einem profusen Schweissausbruch beginnen und dann in allmählich zunehmende Somnolenz, zeitweise auch unterbrochen durch psychotische Erregungen, und schliesslich in Koma übergehen. Dieses Koma kann nun eine verschiedene Tiefe erreichen. In der Somnolenz ist Patient noch weckbar, es ist aber kein Kontakt mehr möglich. Es bestehen noch sämtliche Reflexe, man kann noch durch sehr energisches Zurufen den Patienten zum reflektorischen Schlucken bringen. Allmählich nimmt das Koma an Tiefe zu. Es verschwinden alle Reflexe. In dieser Phase treten bereits pathologische Reflexe auf; Babinski, Oppenheim, Mendel-Bechterew u.a. Bei längerem Zuwarten kann das Koma eine solche Tiefe erreichen, dass sämtliche Reflexe, inklusiv Schluck, Corneal, und Kitzelreflexe, auch die in der früheren Stufe aufgetretenen pathologischen Reflexe, erlöschen. Also vollige Areflexis mit volliger Atonie der gesamten Muskulatur."

This is translated in the first and revised English translations (Sakel, 1935*b*, 1938) as: ". . . the shock starts with profuse perspiration and progressive somnolence and may be interrupted by psychotic excitement, but ends typically in coma. This coma may attain a varying depth. If the patient is merely somnolent he can be awakened, but contact is no longer possible. All the reflexes at this stage are still intact and energetic commands can rouse the patient's swallowing reflexes to the point where the patient will swallow food. But *as the coma deepens* the reflexes become pathological and finally disappear. The patient at first shows positive Babinski, Oppenheim and Mendel-Bechterew reflexes, but *later the coma may become so deep* that all the reflexes disappear, including the corneal and swallowing reflexes, as well as the pathological reflexes which had appeared in the preceding stage, so that we have a complete areflexia with complete atonia of the entire musculature."

It will be seen, therefore, that Sakel made no precise definition of the term "coma," but used it to cover all degrees of the effects of hypoglycaemia from somnolence to complete areflexia. Most British workers have adopted Wilson's (1937) standard of absent corneal reflexes, while the initial unconsciousness, from which the patient cannot be roused and in which the plantar response is frequently extensor is termed "sopor" (von Angyal, 1937). These criteria are adopted in the present paper.

Adopting Wilson's standard of coma, Mahoney and Herskovitz (1942) found that the treatment period was not shortened by intravenous insulin,

that about the same amount of insulin was required to induce coma when given intravenously or intramuscularly, but that the onset of coma occurred about half-an-hour earlier with the former type of administration. The same amount of glucose was required to bring the patient out of coma and one of their patients had 12 convulsions during the course of intravenous insulin. The authors conclude, "our findings indicate that this (intravenous) method of producing hypoglycaemia is not superior to the Sakel method and is not recommended."

Reznikoff and Scott (1942), using a solution of zinc insulin crystals, following Jones (1940) found that there was no economy in the amount of insulin required to produce coma intravenously compared with that needed intramuscularly. Four of their twenty patients developed convulsive seizures, but in general they found that the hypoglycaemia induced was quieter than that of intramuscular insulin. These authors gave up to 1,200 units intravenously to some insulin-resistant cases without producing signs of hypoglycaemia. No allergic reactions followed the use of the zinc insulin crystals. Hypoglycaemia was interrupted two hours after the injection of the insulin, so that complications such as protracted coma were not encountered.

Olsen (1942) followed up McGregor and Sandison's work (1940), but restricted himself to the use of intravenous insulin and glucose with potato starch as a means of preventing after-shock. Using larger quantities of glucose than the latter authors he found the method successful. Olsen does not compare the relative amounts of intravenous and intramuscular insulin required to produce coma.

Polatin and Spotnitz (1942*b*) followed up their earlier work and assessed their results in a series of 33 patients. These do not appear to have been any better than those obtainable with intramuscular insulin, but the authors found that when improvement occurred, it set in more rapidly. This they ascribed, probably correctly, to the more rapid onset of hypoglycaemic symptoms with consequently a greater degree of shock. Low doses with a normal maximum of 40 units were used and it was found that with higher doses "*a protracted coma . . . might ensue.*" It was confirmed that after-shock occurred repeatedly after the injection of insulin intravenously. Although no details are given, apparently a number of patients were allergic to intravenous unmodified insulin and these were switched over to zinc-insulin crystals. This is a point of some importance. Hinko, Fenton and Balberor (1941) record a case of anaphylactoid shock occurring in a patient receiving Sakel's treatment. Generalized pruritus, oedema of the face and cardiovascular collapse were marked and for some time the patient's condition was extremely grave. Later intradermal tests showed him to be definitely sensitive to insulin. Had this patient been given insulin intravenously a fatal outcome of the anaphylactoid shock would have been almost certain.

Goldfarb (1943) states, following his experiment with intravenous and intramuscular insulin, "the production of hypoglycaemic coma by the intravenous route requires essentially the same amount of insulin as the intramuscular route, but the onset of coma occurs earlier after intravenous glucose." This author gives no details of his standard of coma.

In the same year, Peterson and Lutz (1943) reported their findings in a series of cases treated in 1938. They do not compare the relative efficacy of intravenous and intramuscular insulin, but mention that several patients, treated intravenously, went into "after-shock" with low blood sugars when interrupted by nasal glucose. This was prevented by interruption with intravenous glucose. These authors' experience shows, however, that intravenous insulin can, under certain circumstances cause after-shock and that it is not an adequate safeguard by itself against this complication.

It will be seen from the above review of the literature that the effect and value of intravenous insulin in Sakel's treatment are both undecided, as the reports on its use conflict considerably. There is general agreement that the pre-coma time is shortened, but the following summary brings out the conflicting results observed by the various authors on other aspects of this mode of administration as compared with intramuscular injection.

TABLE I.

Authors.	Intravenous coma-dose compared with subcutaneous coma-dose.	Tendency to convulsions.	Coma quieter or not.	After shock.	Incidence of protracted coma.
Ventriglia (1939)	Reduced 50%	Increased	No quieter	—	—
Bardenot and Leonardon (1939)	—	—	Quieter	—	—
McGregor and Sandison (1940)	Reduced 52.4%	—	„	—	—
M. Jones (1940)	Same	—	—	—	—
Polatin, Spotnitz and Wiesel (1940)	—	Reduced	—	Same	—
Horvath and Friedman (1941)	—	—	Quieter	Less	—
Sherman, Mergener and Low (1941)	Reduced (2), increased (3), same (6)	Same	Same	Same	—
Sandison and McGregor (1942)	Reduced 28.3%	—	Quieter	Less	—
Reznikoff and Scott (1942)	Same	Increased	„	—	—
Olsen (1942)	—	—	—	Less	—
Mahoney and Herskovitz (1942)	Same	Increased	—	—	—
Goldfarb (1943)	„	—	—	—	—

In particular, the effect of intravenous insulin on the encephalopathies which complicate intramuscular insulin, such as prolonged coma, have not been reported on, except very briefly by Polatin and Spotnitz (1942a) and the experimental work now to be described was undertaken in order to clarify the position as far as possible.

The first part of the experimental work may be outlined as follows:

Twelve patients, 8 male and 4 female, were given intramuscular and intravenous insulin and the coma dose for each method of administration determined. It was found that while the pre-coma time was shortened *all* the patients required larger doses intravenously than intramuscularly to produce coma. This is at variance with the results obtained by earlier authors, excluding Sherman, Mergener and Low (1941) and an explanation was sought. Three possible explanations suggested themselves:

(1) Some of the intravenous insulin might be excreted rapidly in the urine.

(2) Some of the intravenous insulin might be inactivated by an anti-body in the blood.

(3) While intravenous insulin produces a more rapid fall in the blood sugar than intramuscular insulin, this fact can only be achieved at the cost of considerably more insulin, which is, therefore, more rapidly used up. Despite the greater initial fall, therefore, the intravenous insulin might be unable to maintain the lowered blood-sugar level sufficiently long for coma to supervene unless it were given in greater amounts than when injected intramuscularly.

Experiments were designed to test these hypotheses and the last was found to be correct.

DETAILS OF EXPERIMENTAL WORK.

I. The Comparative Coma Doses of Intravenous and Intramuscular Insulin.

(1) Standard of Coma.

A patient was adjudged to be in coma when he was unconscious, with Babinski plantar responses and absent corneal reflexes. This follows Wilson's (1937) standard and is mentioned in view of the varying standards of coma adopted by various authors. It is considerably deeper, for instance, than Sandison and McGregor's standard (1942) in which the corneal reflexes are present. The point is stressed because a given method of injection of insulin may be able to produce the earlier stages of unconsciousness sooner than another, but, through being exhausted by its more rapid action, it may be unable to produce the deeper stages, which are here designated as coma.

(2) Method of Ascertaining Coma Dose.

In general, all patients were given daily injections of insulin at 7 a.m. with one rest day a week. To commence, 4 male and 2 female patients were given 20 units intravenously and the dose increased by 20 units daily until "sopor" was obtained, after which the daily increment was reduced by varying amounts until coma was reached. Thereafter, with the onset of sensitivity the dose required to induce coma was found to be progressively less until a minimum was reached, below which the dose could not be reduced if coma were to result. The patients were then "rested" for 14 days and the process repeated with intramuscular insulin. It was found that the degree of sensitivity developed was approximately the same with both methods of administration (see Table III). This is contrary to Sandison and McGregor's (1942) findings, who found a greater sensitivity to intravenous than to intramuscular insulin. As there was no difference in the sensitivity induced by the two methods, it was concluded that it would be sufficiently accurate to determine only the dose required to induce the initial coma and this was done in a further 6 patients, making a total of 8 male and 4 female cases.

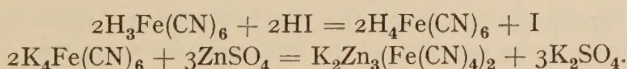
(3) Blood-Sugar Estimations.

In view of the findings of previous workers, e.g. Norgaard and Thaysen (1929) and Sherman, Mergener and Low (1941) that the lowest blood-sugar level following intravenous insulin is found from 25-40 minutes after injection,

the blood sugar was usually estimated at the following intervals after injection : 25, 30, 35, 40, 50, 60, 70, 90, 110, 130, 160, 180, 210, 240 and 270 minutes. The blood was drawn from the distal phalanx of the thumb, a small rubber tourniquet being wound around the thumb proximal to the site of puncture. This probably resulted in a certain amount of tissue exudation, but as with practice the withdrawal of the blood into the pipette could be done very quickly this factor does not appear of practical importance, especially as a more liberal quantity of blood was consistently available than could have been so with, say, non-pressure pricking of the lobe of the ear. The blood sugar was estimated by a modified method of Hagedorn and Jensen (1923) as follows :

One c.c. of 0.1 NaOH and 5 c.c. of 0.45 per cent. zinc sulphate solution were pipetted into a test-tube (15 × 150 mm.) ; 0.12 c.c. of blood was introduced from a capillary pipette and the mixture placed in a boiling-water bath for 3 minutes, following which it was cooled and diluted to 12 c.c. The blood protein which has been precipitated by the zinc hydroxide formed by the interaction of the sodium hydroxide and zinc sulphate was then filtered out on a funnel of 3-4 cm. diameter, prepared with a dry, acid-washed, No. 40 Whatman filter paper, following the assertion of Kramer and Steiner (1931), that the variable density of the cotton filter recommended by Hagedorn and Jensen gave rise to erroneous results. 10 c.c. of the filtrate, corresponding to 0.1 c.c. of blood were taken and neutralized with 0.30 of 0.1N sodium hydroxide in order to prevent changes in the alkalinity of Hagedorn-Jensen potassium ferricyanide reagent, 2 c.c. of which were then added to the 10 c.c. of filtrate. This mixture was then heated in a boiling-water bath for 15 minutes. After cooling, 3 c.c. of iodide-sulphate chloride solution ($KI + ZnSO_4 + NaCl$) and 2 c.c. of 3 per cent. acetic acid solution were added. The amount of the potassium ferricyanide reduced by the glucose was determined by finding the amount of iodine set free through titration with 0.005 N sodium thiosulphate using as an indicator 2 drops of 1 per cent. solution of soluble starch in saturated sodium chloride solution.

The principal reactions of the process are :



The reversal of the reduction process is prevented by the precipitation of the ferrocyanide formed as a zinc salt by the zinc sulphate.

Calculation.—(a) A blank was first obtained by carrying through the whole process, but without the addition of blood. This blank was never allowed to exceed 0.2.

(b) The thiosulphate burette reading was multiplied by the factor for the thiosulphate (2.00 c.c. thiosulphate required for 2 c.c. of 0.005 N potassium sulphate). This gives value (A). This value (A) was expressed for the unknown and for the blank by consulting tables provided. The glucose value of the blank was subtracted from the glucose value of the unknown to give the mgm. glucose in 0.1 c.c. of blood, from which the amount present in 100 c.c. of blood was calculated.

Interpretation of results.—The method of Hagedorn and Jensen for estimating the blood sugar was selected in preference to that of Folin and Wu, as it gives more accurate results in the very low blood-sugar levels encountered in Sakel's hypoglycaemic treatment. In addition to the glucose, the blood contains 20–30 mgm.—as glucose—per 100 c.c. of non-fermentable reducing substances, chiefly glutathione which is present in the red blood corpuscles. It is, however, incorrect to calculate the true glucose by deducting the amount of the non-fermentable reducing substances from the "enhanced-glucose" values because in different methods varying proportions of these non-fermentable reducing substances are included. In the Hagedorn and Jensen method 4 mgm. per 100 c.c. only are to be deducted, while in the Folin and Wu method 11 mgm. per 100 c.c. have to be deducted. If, therefore, the blood-sugar values obtained in this present study are reduced by 4 mgm. per cent., the resulting figures give an approximate true glucose value (Harrison, 1945).

(4) *Results Obtained.*

The blood-sugar values obtained in the 12 patients following the intramuscular and intravenous injection of insulin in increasing doses from 20 units to coma dose are set out in Table II.

From Table II the doses of insulin required initially to induce "sopor" and coma were abstracted and are set out in Table III, along with the doses needed to induce these states after the patients had become sensitized to the insulin.

The results summarized in the above table differ from those of previous workers except Sherman, Mergener and Low (1941), three of whose patients required more insulin intravenously than subcutaneously to induce coma. It will be seen that all of the 12 patients in the series required more intravenous than intramuscular insulin for the production of coma. The percentage difference has not been calculated, as such figures are unreliable under the non-standardized conditions of Sakel's treatment as usually practised, and especially in view of the variation in the response to insulin of individual patients. McGregor and Sandison (1940) found that the intravenous "coma dose" varied from 25 per cent. to 75 per cent. of the intramuscular coma dose. With such widely divergent figures, percentage averages are of little value unless very large numbers of patients are being considered. It will be noticed that while more intravenous than intramuscular insulin is needed to induce coma with areflexia, less is needed to induce "sopor" (unconsciousness). In Table II usually 20 units less is required, but the actual figure is probably lower than this, as the insulin at this stage of the experiment was being increased by 20 units daily, and had the increment been smaller, the patients would probably have gone into "sopor" on intramuscular insulin on a slightly lower dose. The figures for the differences between the sensitized "sopor" doses are probably more accurate, as these were arrived at over a period of some days. In view of the consistency of the above results, an explanation was then sought to account for the way in which they differ from those of earlier workers, who had found either a smaller or the same amount of intravenous insulin was

TABLE II.—*Blood-sugar Values Following Injection of Intramuscular and Intravenous Insulin in Increasing Doses from 20 Units to Coma Dose.*

The doses required to induce "sopor" are marked with †.

The doses required to induce coma are marked with an asterisk.

I.M. = intramuscular; I.V. = intravenous.

Patient 1—Male:

Units of insulin.		Fasting blood sugar.	Minutes after injection.														
			25.	30.	35.	40.	50.	60.	75.	90.	120.	150.	180.	210.	240.	270.	
20 I.M.	.	75	.	56				47		50	47	50	48	47	54	54	
20 I.V.	.	83	.	38	29	31	25	30	38	45	53	66	72	81	81	83	
40 I.M.	.	90	.	79				45		34	41	43	48	47	47	51	
40 I.V.	.	81	.	34	30	32	29	32	33	35	39	48	59	70	78	79	
60 I.M.	.	90	.	70				45		45	45	41	41	41	43	45	
60 I.V.	.	78	.	42	37	35	32	37	38	42	47	54	64	66	76	78	
80 I.M.	.	92	.	65				35		35	41	34	34	38	38	36	
80 I.V.†	.	88	.	39	31	31	25	24	29	32	39	51	56	72	83	85	
100 I.M.†	.	100	.	72				38		36	36	34	34	34	36	36	
100 I.V.	.	92	.	35	27	23	23	22	29	31	33	41	45	47	56	67	
120 I.M.	.	110	.	60				36		28	31	33	31	33	33	34	
120 I.V.	.	88	.	24	24	22	20	24	27	25	29	29	36	38	45	56	
140 I.M.*	.	80	.	72				33		21	23	23	25	26	28	28	
140 I.V.	.	77	.	39	43	24	22	27	34	30	34	32	32	35	44	49	
160 I.V.	.	74	.	48	46	43	27	24	31	27	36	39	36	37	42	43	
174 I.V.*	.	83	.	56	35	32	25	19	18	20	24	26	28	29	30	29	

Patient 2—Male:

20 I.M.	111		86				65		56	50	54	72	77	83	80
20 I.V.	106	57	47	41	36	34	41	45	54	75	95	90	92	93	102
40 I.M.	104		84				50		43	43	43	47	52	59	65
40 I.V.	108	65	54	34	41	39	43	47	47	66	77	86	96	95	95
60 I.M.	88		64				41		36	41	45	43	50	43	47
60 I.V.	92	56	50	41	32	32	32	27	32	35	43	63	72	81	87
80 I.M.	98		70				39		41	50	48	52	47	45	48
80 I.V.†	97	56	45	38	31	32	36	32	32	38	46	55	61	75	83
100 I.M.†	101		70				43		41	39	36	41	36	38	38
100 I.V.	86	63	48	31	36	27	27	24	27	38	38	47	53	70	77
120 I.M.	95		54				42		38	36	36	29	25	38	39
120 I.V.	88	77	61	34	32	32	31	36	33	35	36	41	49	61	68
130 I.M.	96		61				45		35	33	29	29	24	31	35
130 I.V.	92	61	47	33	31	32	31	34	31	33	37	45	46	57	63
140 I.M.*	92		74				48		27	24	27	27	24	27	24
140 I.V.	102	72	66	59	45	34	34	32	31	34	38	42	48	52	57
160 I.V.	94	60	48	34	30	30	31	31	31	33	35	36	40	46	44
170 I.V.*	96	55	44	34	29	31	29	32	35	31	29	32	29	31	33

Patient 3—Male:

20 I.M.	88		63				43		41	34	38	43	57	70	82
20 I.V.	75	32	27	25	25	27	29	27	34	55	63	75	83	80	79
40 I.M.	86		48				24		29	29	29	36	38	41	43
40 I.V.†	79	44	34	27	22	22	24	24	29	33	47	66	72	79	79
60 I.M.†	95		54				25		32	31	32	38	38	38	41
60 I.V.	92	32	28	24	19	19	22	27	25	30	43	54	63	74	88
80 I.M.	104		47				27		27	27	24	31	32	31	31
80 I.V.	95	36	29	29	19	19	19	25	24	24	29	36	47	68	74
86 I.M.	92		79				48		34	29	27	31	29	32	
86 I.V.	89	45	31	30	22	21	20	22	23	23	26	37	46	57	69
92 I.M.*	97		60				29		27	27	27	25	27	29	27
92 I.V.	93	38	30	22	23	21	20	19	21	25	27	36	43	54	63
100 I.V.	101	36	32	24	24	24	19	19	20	22	27	36	39	47	59
110 I.V.	99	34	24	22	15	15	19	15	19	21	30	29	34	36	43
118 I.V.*	95	32	29	24	18	18	17	18	20	22	21	25	27	26	29

TABLE II—(contd.).

The doses required to induce "sopor" are marked with †.
The doses required to induce coma are marked with an asterisk.
I.M. = intramuscular; I.V. = intravenous.

Patient 4—Female:

Units of insulin.		Fasting blood sugar.	Minutes after injection.														
			25.	30.	35.	40.	50.	60.	75.	90.	120.	150.	180.	210.	240.	270.	
20	I.M.	106		81				59		53	57	56	57	54	57	57	
20	I.V.	108	72	48	36	34	31	31	45	47	66	86	90	93	95	98	
40	I.M.	99		90				65		39	39	45	38	39	38	45	
40	I.V.	95	45	32	29	20	15	20	22	22	48	54	68	75	75	83	
60	I.M.	90		70				36		31	28	31	31	35	45	50	
60	I.V.†	90	36	27	24	20	25	27	22	34	47	55	58	59	71	83	
80	I.M.†	92		72				31		19	19	19	23	31	32	39	
80	I.V.	88	57	39	32	24	22	24	25	25	26	34	41	54	70	75	
90	I.M.	97		76				39		24	17	18	20	25	27	35	
90	I.V.	93	43	35	34	29	26	26	32	30	29	34	36	41	49	56	
98	I.M.*	88		60				31		20	18	18	20	22	20	19	
98	I.V.	101	60	54	33	32	25	24	31	29	23	33	36	38	41	41	
110	I.V.	96	54	40	32	29	25	23	24	25	23	26	28	34	37	39	
118	I.V.*	86	65	54	39	32	22	18	14	15	15	17	15	16	18	—	

Patient 5—Male:

20 I.M.	106		94				79		75	79	85	92	96	98	101
20 I.V.	94	62	56	54	56	60	68	72	78	89	90	91	90	92	91
40 I.M.	92		78				68		58	62	67	71	75	83	89
40 I.V.	97	63	52	52	50	56	67	75	81	90	95	93	96	96	96
60 I.M.	93		84				67		57	65	66	68	70	74	77
60 I.V.	99	58	47	43	47	53	59	69	78	87	95	94	94	96	95
80 I.M.	104		63				63		61	54	57	59	59	63	67
80 I.V.	93	54	43	31	41	49	54	63	72	81	86	85	87	89	87
100 I.M.	92		72				34		43	50	48	56	56	59	61
100 I.V.†	95	48	33	27	35	39	43	55	56	64	76	89	93	97	97
120 I.M.†	95		60				46		43	40	54	54	54	55	57
120 I.V.	89	40	31	23	28	32	35	51	64	69	74	78	83	85	85
140 I.M.	97		57				36		34	36	41	41	39	41	42
140 I.V.	96	55	41	25	19	21	30	34	45	54	59	63	69	69	68
152 I.M.	92		71				39		31	34	28	34	36	34	32
152 I.V.	86	43	35	26	18	19	25	29	27	35	39	47	46	49	54
164 I.M.	90		62				32		27	25	25	27	26	24	26
164 I.V.	99	52	39	23	20	22	23	19	26	30	34	38	40	43	42
176 I.M.	98		59				28		22	18	20	21	23	25	24
176 I.V.	93	49	43	27	17	18	20	25	27	23	29	33	35	35	36
188 I.M.*	88		52				24		20	17	19	20	22	22	23
188 I.V.	95	47	35	25	21	19	24	27	29	33	26	30	33	31	30
200 I.V.	89	39	26	29	19	17	23	25	27	29	31	29	33	33	28
212 I.V.	93	45	28	24	21	20	22	23	25	26	24	23	25	23	24
220 I.V.*	87	66	44	30	19	17	18	20	22	21	19	21	23	23	21

Patient 6—Female:

20 I.M.	92		86				65		39	41	39	50	45	47	47
20 I.V.	95	43	31	29	31	24	26	31	38	47	59	80	93	93	94
40 I.M.	99		83				45		25	27	27	31	29	29	29
40 I.V.	99	34	32	29	31	31	36	41	41	43	54	71	78	87	93
56 I.M.	120		74				45		31	31	31	27	20	24	31
56 I.V.†	97	27	24	23	17	20	25	32	33	34	37	37	41	56	67
68 I.M.†	122		74				34		27	31	29	29	19	25	29
68 I.V.	102	43	30	25	20	27	25	28	33	31	34	36	40	45	52
80 I.M.	96		56				32		27	24	24	23	24	27	29
80 I.V.	115	34	31	27	25	23	25	36	31	34	39	38	41	41	43
92 I.M.*	113		47				29		25	21	19	22	22	22	25
92 I.V.	97	39	34	—	20	31	27	31	31	25	32	30	31	33	37
104 I.V.	108	34	31	25	24	19	25	27	25	26	29	31	29	33	33
114 I.V.*	96	27	29	25	22	27	25	24	22	21	23	25	22	20	20

TABLE II—(contd.).

The doses required to induce "sopor" are marked with †.

The doses required to induce coma are marked with an asterisk.

I.M. = intramuscular; I.V. = intravenous.

Patient 7—Male:

Units of insulin.	Fasting blood sugar.	Minutes after injection.															
		25.	30.	35.	40.	50.	60.	75.	90.	120.	150.	180.	210.	240.	270.		
20 I.M.	. 95	.	70				63		38	31	32	29	32	34	34		
20 I.V.	. 108	. 48	39	25	32	27	32	33	36	43	50	74	87	93	97		
40 I.M.	. 120	.	78				41		29	27	26	25	44	45	46		
40 I.V.	. 106	. 57	45	39	27	29	24	25	27	31	61	72	83	95	92		
60 I.M.	. 99	.	90				67		38	25	15	19	28	28	36		
60 I.V.	. 106	. 50	39	29	29	29	27	31	24	34	52	63	75	89	94		
80 I.M.	. 109	.	83				61		25	22	27	31	31	31	36		
80 I.V.†	. 125	. 59	47	38	32	24	22	24	19	22	31	44	36	48	54		
92 I.M.†	. 120	.	93				56		25	17	19	20	22	27	25		
92 I.V.	. 111	. 48	31	24	24	19	15	20	20	27	36	32	36	36	43		
100 I.M.*	. 119	.	81				39		22	20	19	20	19	21	23		
100 I.V.	. 96	. 50	41	27	24	22	23	24	34	27	28	30	34	35	35		
110 I.V.	. 112	. 43	29	25	29	31	25	22	25	32	29	32	34	29	29		
118 I.V.*	. 101	. 45	20	19	19	17	20	19	19	20	22	25	24	28	30		

Patient 8—Male:

20 I.M.	. 98	.	74				34		36	27	27	37	38	39	50		
20 I.V.	. 115	. 31	27	29	31	32	39	43	45	61	78	92	95	97	89		
40 I.M.	. 95	.	72				36		32	32	29	38	32	36	38		
40 I.V.†	. 100	. 29	23	24	23	24	22	18	25	41	43	50	65	72	87		
52 I.M.†	. 93	.	56				32		29	29	31	27	33	35	34		
52 I.V.	. 97	. 33	21	21	24	26	27	27	30	38	41	43	53	61	74		
60 I.M.*	. 106	.	36				27		26	27	25	19	19	17	21		
60 I.V.	. 95	. 34	19	24	25	32	29	27	25	35	38	41	45	49	54		
68 I.V.	. 108	. 32	36	22	21	19	19	19	22	27	34	34	39	45	45		
76 I.V.*	. 117	. 39	32	22	21	21	22	20	17	23	24	29	30	28	—		

Patient 9—Male:

20 I.M.	. 96	.	61				38		40	43	47	51	51	57	65		
20 I.V.	. 94	. 56	39	32	33	35	39	45	46	57	73	81	87	88	87		
40 I.M.	. 106	.	65				45		29	29	29	32	36	31	38		
40 I.V.†	. 90	. 35	22	23	25	27	29	33	39	40	44	58	65	76	84		
60 I.M.†	. 111	. 83					34		22	22	22	25	29	29	33		
60 I.V.	. 99	. 31	21	19	19	23	26	27	30	36	42	51	55	61	67		
72 I.M.	. 92	.	68				24		24	16	17	23	25	25	27		
72 I.V.	. 98	. 37	21	18	19	23	21	25	25	29	35	41	46	55	59		
80 I.M.*	. 95	.	66				18		18	17	15	17	17	20	21		
80 I.V.	. 92	. 36	24	20	20	23	23	24	24	30	32	33	38	42	53		
88 I.V.	. 98	. 32	22	18	19	18	22	24	25	27	30	31	35	35	33		
96 I.V.	. 90	. 40	21	20	18	19	20	19	20	25	23	24	30	29	31		
104 I.V.*	. 99	. 32	24	20	17	17	16	15	17	19	20	19	24	23	24		

Patient 10—Male:

20 I.M.	. 98	.	61				39		38	42	47	51	54	53	57		
20 I.V.	. 93	. 33	27	30	31	34	37	40	42	57	72	82	88	89	88		
40 I.M.	. 96	.	56				31		31	38	31	31	29	34	36		
40 I.V.	. 92	. 34	29	27	29	32	29	31	32	41	67	77	84	84	86		
60 I.M.	. 93	.	54				41		34	34	32	32	33	33	35		
60 I.V.†	. 97	. 43	38	26	25	26	27	28	30	35	45	64	70	70	72		
72 I.M.†	. 88	.	61				38		27	31	32	31	31	30	29		
72 I.V.	. 100	. 39	29	25	22	20	29	29	29	24	34	43	54	63	69		
84 I.M.	. 97	.	58				31		23	25	27	25	26	29	28		
84 I.V.	. 90	. 43	32	25	27	29	26	19	22	24	28	32	41	53	56		
94 I.M.*	. 92	.	54				25		20	19	23	20	19	21	20		
94 I.V.	. 98	. 38	26	24	19	22	23	21	22	22	28	32	38	47	46		
106 I.V.	. 93	. 32	22	22	19	22	24	22	24	20	26	26	35	36	38		
114 I.V.*	. 100	. 52	33	32	31	19	20	23	23	24	22	22	21	23	26		

TABLE II—(contd.).

The doses required to induce "sopor" are marked with †.
The doses required to induce coma are marked with an asterisk.
I.M. = intramuscular; I.V. = intravenous.

Patient 11—Female:

Units of insulin.	Fasting blood sugar,	Minutes after injection.														
		25.	30.	35.	40.	50.	60.	75.	90.	120.	150.	180.	210.	240.	270.	
20 I.M.	81		59				47		47	45	45	45	45	47	54	
20 I.V.	79	45	36	25	31	36	36	41	47	60	72	74	75	74	76	
40 I.M.	90		74				43		39	38	38	39	36	41	47	
40 I.V.	86	25	19	27	27	27	33	36	40	45	54	63	63	72	81	
60 I.M.	90		65				41		41	45	43	39	45	39	38	
60 I.V.	93	59	41	36	31	41	38	52	47	46	45	48	59	68	74	
80 I.M.	92		70				36		32	32	36	41	36	39	34	
80 I.V.†	86	41	29	25	24	29	32	36	43	39	41	47	52	63	74	
100 I.M.†	88		59				34		32	32	31	36	32	31	30	
100 I.V.	86	43	34	29	24	32	34	32	36	37	41	50	51	52	63	
120 I.M.	101		57				39		32	32	36	38	32	39	35	
120 I.V.	90	52	38	31	30	27	32	32	32	34	38	43	45	49	54	
132 I.M.	86		56				38		30	29	30	31	33	33	35	
132 I.V.	93	41	32	27	29	30	31	33	32	30	36	38	39	41	45	
144 I.M.*	86		43				29		27	24	24	27	25	29	30	
144 I.V.	99	41	29	24	19	22	24	31	32	34	36	37	39	43	47	
156 I.V.	90	39	34	31	25	22	28	30	30	31	33	35	34	38	43	
168 I.V.*	91	38	31	26	22	22	24	24	24	27	29	27	31	29	33	

Patient 12—Female:

20 I.M.	96		81				76		69	67	67	72	75	79	79
20 I.V.	91	65	49	38	44	58	64	65	64	67	77	89	91	89	90
40 I.M.	89		67				55		52	55	59	57	63	61	65
40 I.V.	82	69	26	22	27	36	38	38	49	53	67	73	81	81	83
60 I.M.	97		59				47		40	43	46	47	48	51	53
60 I.V.	92	38	32	36	32	29	34	43	45	47	52	52	63	72	71
80 I.M.	95		65				42		41	39	37	37	41	43	45
80 I.V.	83	45	34	29	24	30	39	39	39	41	43	49	57	65	65
100 I.M.	89		53				43		45	43	43	39	43	47	45
100 I.V.†	90	47	32	27	23	29	38	37	36	39	45	45	51	55	59
120 I.M.	95		67				38		37	39	38	40	43	41	41
120 I.V.	97	46	33	31	29	27	34	42	42	39	38	43	45	47	51
140 I.M.†	91		63				32		35	35	33	35	36	34	37
140 I.V.	101	47	36	25	23	24	31	35	37	42	39	37	41	45	47
160 I.M.	93		68				37		33	31	33	34	34	35	34
160 I.V.	96	37	32	21	23	21	27	33	33	35	39	41	43	43	45
172 I.M.	88		63				30		27	28	30	31	30	29	31
172 I.V.	93	36	28	23	21	24	25	25	27	31	35	31	33	34	37
184 I.M.	97		58				21		24	23	22	23	24	26	26
184 I.V.	95	40	27	25	23	22	22	25	28	30	33	36	34	33	35
196 I.M.*	93		54				22		19	17	16	20	22	21	21
196 I.V.	89	29	26	19	23	23	21	23	25	27	29	33	35	35	33
208 I.V.	91	36	24	20	21	24	22	23	23	21	25	27	25	27	29
220 I.V.	83	31	27	23	17	19	20	23	23	25	26	24	25	26	27
232 I.V.*	96	32	28	21	19	17	20	19	18	21	20	19	21	21	22

TABLE III.

Units of insulin required to produce—

Patient number.	Sex of patient.	Initial sopor.		Sopor following sensitization.		Initial coma.		Coma following sensitization.	
		I.M.	I.V.	I.M.	I.V.	I.M.	I.V.	I.M.	I.V.
1	M.	100	80	74	62	140	174	98	130
2	M.	100	80	66	52	140	170	94	112
3	M.	60	40	42	30	92	118	70	88
4	F.	80	60	42	32	98	118	64	78
5	M.	120	100	92	78	188	220	150	166
6	F.	68	56	38	32	92	114	56	72
7	M.	92	80	—	—	100	118	—	—
8	M.	52	40	—	—	60	76	—	—
9	M.	60	40	—	—	80	104	—	—
10	M.	72	60	—	—	94	114	—	—
11	F.	100	80	—	—	144	168	—	—
12	F.	140	100	—	—	196	232	—	—

required to produce coma as compared with intramuscular insulin. Three hypotheses to explain the present findings suggest themselves as follows:

(1) *Excretion of intravenous insulin in the urine.*—The sudden injection of a large quantity of insulin directly into the blood stream might lead to some of the urine being excreted in the urine, and so have no effect upon the level of the blood sugar.

(2) *Destruction of the intravenous insulin by circulating substances in the blood.*—Substances circulating in the blood stream might neutralize part of the large amounts of insulin injected intravenously, and so reduce the efficacy of the insulin in maintaining the blood sugar at low levels for a sufficient period for coma to ensue.

(3) *Rapid but not prolonged action of intravenous insulin.*—Most drugs which can be given intravenously and subcutaneously or intramuscularly have a more rapid but less prolonged action when given by the former as compared with the latter routes. *A priori*, one would expect this to be true also of insulin, so that while it would be possible to produce the milder results of hypoglycaemia, such as perspiration, "sopor," etc., more rapidly with intravenous than with subcutaneous insulin, the action of the drug given intravenously would not be sufficiently prolonged to produce the much deeper hypoglycaemic state of coma with complete areflexia unless it was given in increased doses.

These hypotheses were then put to experimental proof:

(1) *Excretion of Intravenous Insulin in the Urine.*

The possibility that some of the insulin injected intravenously may be excreted quickly by the kidneys follows from the work of Fisher and Noble (1923), who were able to recover from a dog's urine 35 out of 40 units of insulin which had been given intravenously in divided doses of 10 units at hourly intervals under veronal anaesthesia. This work was confirmed by Bruger and Friedman (1938). Recordier and Andrac (1935) found that the hypoglycaemic action of insulin administered to dogs intravenously was consistently prolonged after bilateral nephrectomy. Goadby and Richardson (1940) injected 40 units of insulin into rabbits, and then injecting samples of blood withdrawn at varying intervals found that the blood-sugar level of the latter

animals became depressed, and ascribed the hypoglycaemic effect to the insulin still in the blood of the first animal. Normally the hypoglycaemic effect could be induced if the blood were withdrawn within 90 minutes of the original injection, but if the kidneys were excluded from the circulation, the hypoglycaemic activity lasted considerably longer.

It would thus appear fairly certain that in animals insulin injected intravenously is partly excreted in the urine. The fact that it appears in the urine in a form capable of producing hypoglycaemia (Bruger and Friedman, 1935) indicates that it has been excreted before it has exercised its full hypoglycaemic effects, and it may therefore be that more insulin would be required to produce given results when administered intravenously than subcutaneously owing to its being excreted more rapidly when given by the former route.

The evidence for the excretion by the kidneys of insulin in normal and diabetic human subjects has been very conflicting. The literature is reviewed by Cutting (1942), who also devised a method by which 0.25 units insulin per 100 ml. urine, added *in vitro*, could be detected. She found that no insulin could be detected in normal urine, and that, if present, it must be there in amounts of less than 0.25 unit/100 ml.

Cutting's method consisted of adding 0.5 ml. of rabbit plasma to 100 ml. of urine which had been adjusted to a pH of 5.0 (isoelectric point of insulin). 32 gm. of crystalline ammonium sulphate was added to half-saturate the solution, and the mixture was stirred and kept in a warm place in order that the resulting precipitate which contained the insulin should flocculate. The precipitate was filtered out, dried and ground up in a mortar with 10 ml. of a borate buffer solution at pH 8.0. Some of the precipitate which did not dissolve was removed by centrifuge. The supernatant liquid which contained the insulin was then injected into test animals, and the blood-sugar curves estimated by the Hagedorn and Jensen method.

Dr. C. H. Gray kindly undertook the examination of the urine of 4 patients (2 male and 2 female) who were each given intravenous injections of 500, 750 and 1,000 units of insulin on successive days. The male patients were instructed to empty their bladders immediately before injection, and the female patients were catheterized. In order to ensure diuresis the patients were given 1 pint of plain water to drink immediately after the injection. Half an hour after injection the male patients emptied their bladders as far as possible spontaneously, while the female patients were catheterized. This was repeated one hour after the injection. Each patient was then given 250 c.c. of 33 per cent. glucose intravenously to abort or prevent the onset of hypoglycaemia, and this together with adequate sugar by mouth was found sufficient despite the large doses of insulin given.

The insulin was given in the large doses of 500, 750 and 1,000 units, because it was felt that if no insulin could be detected in the urine following such doses there was little point in attempting to find it using the usual doses necessary in Sakel's method (approximately 60-300 units).

Results.—Two specimens of urine, one at 30 minutes and the other at 60 minutes after the intravenous injection of 500, 750 and 1,000 units in each of 2 male and 2 female patients, were examined. All the tests were negative.

In view of the delicacy of the test by which insulin in the proportion of 0.25/100 ml. could be detected, the very large amounts of insulin injected, 500-1,000 units, and the unequivocal nature of the results, it must be concluded that no part of insulin injected intravenously in man is excreted in the urine.

(2) *Destruction of Intravenous Insulin by Circulating Substances in the Blood.*

The injection into the blood stream of the quantities of insulin given in the experiments (20-232 units) represents a very large increase over the minute quantity of insulin normally present, and it is possible that some of it may be neutralized by substances, such as adrenaline, which are already circulating in the blood. The large quantities injected make it unlikely that all the insulin would be destroyed in this way, but sufficient might be thus neutralized to account for the more temporary nature of the action of insulin administered intravenously, as compared with the more prolonged action of insulin given by the subcutaneous and intramuscular routes. To test whether this is so, the following experiment was carried out:

Experiment.—Four patients (2 male and 2 female) were selected and given no insulin for a fortnight. Each was then given 2 units of insulin daily for 24 days under the following conditions:

(a) On the first and succeeding *odd* days (1, 3, 5, etc.) 2 units of soluble insulin were given intravenously in the usual way and the blood-sugar levels charted during the following 150 minutes, by which time the blood sugar had returned to normal.

(b) On the second and succeeding *even* days (2, 4, 6, etc.) 100 c.c. of the patients' blood were removed from an ante-cubital vein, and to it were added 2 units of insulin, with very gentle mixing to ensure the even distribution of the insulin throughout the blood. The blood was then kept at 37° C. for 60 minutes and then injected into the patient intravenously. It was injected under pressure from a reversed Wolff's bottle, and the average time taken for the injection was 45-60 seconds. The blood-sugar level was then charted at intervals for the next 150 minutes. At the end of the 24 days there had been obtained for each of the 4

TABLE IV.

(A) 2 units of insulin intravenously.

(B) 2 units of insulin mixed with 100 c.c. of the patient's blood, kept at body heat for 1 hour and then injected intravenously.

		Fasting blood sugar.	Minutes after injection.												
			10.	15.	20.	25.	30.	35.	40.	50.	60.	75.	90.	120.	150.
Patient 1 (M.):															
(A)		99	75	70	61	62	55	57	61	67	73	80	88	94	95
(B)		94	74	63	60	56	53	55	60	70	75	81	88	94	99
Patient 2 (M.):															
(A)		94	76	72	69	66	62	63	69	77	82	87	91	94	94
(B)		95	76	71	69	66	63	65	69	78	85	86	93	94	95
Patient 3 (F.):															
(A)		91	73	66	58	48	49	51	58	64	71	76	85	90	90
(B)		92	73	65	57	50	49	51	56	64	71	76	84	90	91
Patient 4 (F.):															
(A)		89	66	59	52	46	46	47	53	58	68	76	82	88	89
(B)		92	67	59	52	46	44	46	53	60	75	75	82	88	90

TABLE V.—*Blood-sugar Values Following (A) the Intravenous Injection of 2 Units of Insulin and (B) Intravenous Injection of 2 Units of Insulin Mixed with 100 c.c. of the Subject's Blood and Kept at Body Heat for 60 Minutes.*

Patient	Day of experiment.	Fasting blood sugar.	Minutes after injection.														
			10.	15.	20.	25.	30.	35.	40.	50.	60.	75.	90.	120.	150.		
Patient 1:																	
1 (A)	.	97	. 70	63	54	54	57	61	65	67	68	76	81	95	96		
2 (B)	.	101	. 75	68	57	53	45	53	62	71	73	79	83	98	99		
3 (A)	.	93	. 72	66	61	56	56	57	59	65	68	73	79	91	94		
4 (B)	.	97	. 70	61	59	52	55	57	61	67	72	77	85	99	98		
5 (A)	.	92	. 74	69	63	56	54	57	65	67	74	77	82	88	90		
6 (B)	.	89	. 69	63	56	55	53	59	63	69	77	75	81	89	92		
7 (A)	.	97	. 75	65	61	56	57	59	68	70	73	76	80	91	93		
8 (B)	.	93	. 79	69	63	59	57	61	61	68	69	77	83	92	89		
9 (A)	.	89	. 74	66	61	66	66	61	65	75	79	86	89	88	89		
10 (B)	.	99	. 72	65	64	59	59	59	61	73	75	77	81	95	96		
11 (A)	.	98	. 76	66	64	57	59	57	63	75	81	89	95	99	99		
12 (B)	.	91	. 71	52	57	52	51	49	55	67	77	85	87	89	86		
13 (A)	.	99	. 82	76	70	65	52	56	53	66	72	83	93	96	96		
14 (B)	.	87	. 78	68	59	57	57	56	62	69	81	87	89	89	89		
15 (A)	.	91	. 75	70	63	52	52	54	54	59	66	79	87	89	89		
16 (B)	.	96	. 76	67	62	58	55	57	65	69	76	81	89	94	95		
17 (A)	.	102	. 75	68	59	58	57	58	61	70	76	81	93	99	101		
18 (B)	.	93	. 73	61	63	55	53	57	63	67	71	75	87	92	93		
19 (A)	.	108	. 76	68	64	61	59	59	56	68	75	87	99	104	104		
20 (B)	.	97	. 77	63	67	59	53	54	61	71	77	81	95	96	94		
21 (A)	.	91	. 71	61	56	52	45	54	61	65	78	84	89	90	90		
22 (B)	.	95	. 75	68	55	54	44	49	57	67	82	87	97	96	91		
23 (A)	.	92	. 74	65	55	49	45	54	52	56	63	72	85	93	93		
24 (B)	.	95	. 71	65	59	56	49	47	49	59	73	79	93	93	96		
Average blood-sugar levels:																	
(A)	.	98	. 75	70	61	62	55	57	61	67	73	80	88	94	95		
(B)	.	94	. 74	63	60	56	53	55	60	70	75	81	88	94	99		
Patient 2:																	
1 (A)	.	102	. 84	73	69	68	63	65	72	77	82	89	96	102	102		
2 (B)	.	91	. 75	69	68	64	61	62	67	75	81	90	91	92	92		
3 (A)	.	98	. 78	69	66	64	61	63	69	76	89	92	94	94	93		
4 (B)	.	97	. 79	71	66	66	64	64	71	81	85	87	91	98	98		
5 (A)	.	90	. 76	73	71	69	65	66	73	81	85	89	92	93	93		
6 (B)	.	97	. 81	72	72	70	65	67	69	77	86	91	98	99	99		
7 (A)	.	93	. 81	73	68	63	63	63	67	74	79	85	89	91	91		
8 (B)	.	96	. 74	69	67	64	61	64	73	79	87	87	93	96	95		
9 (A)	.	89	. 72	65	64	59	57	57	63	76	81	86	89	90	88		
10 (B)	.	93	. 69	61	65	64	62	61	66	81	85	89	90	89	89		
11 (A)	.	91	. 73	73	71	70	68	67	74	79	83	87	87	90	91		
12 (B)	.	99	. 77	71	69	67	67	69	70	77	85	89	98	99	99		
13 (A)	.	97	. 75	68	67	65	59	65	69	77	84	86	89	95	95		
14 (B)	.	97	. 81	77	73	65	63	64	68	75	86	86	93	95	98		
15 (A)	.	95	. 79	73	71	67	61	63	67	84	87	85	91	96	96		
16 (B)	.	93	. 73	71	71	70	76	70	74	81	86	89	91	92	93		
17 (A)	.	96	. 81	74	69	63	59	59	66	77	83	89	93	93	93		
18 (B)	.	97	. 78	76	73	65	63	63	69	81	79	85	94	94	96		
19 (A)	.	96	. 82	76	74	68	65	65	69	76	81	87	89	93	95		
20 (B)	.	99	. 78	72	71	65	61	64	68	77	83	91	102	98	98		
21 (A)	.	94	. 77	69	67	65	61	63	69	74	79	79	89	92	92		
22 (B)	.	91	. 74	73	70	67	57	65	69	79	89	89	90	91	91		
23 (A)	.	99	. 79	73	71	68	63	65	71	71	81	87	99	98	99		
24 (B)	.	91	. 72	72	68	63	61	61	68	75	85	89	90	89	89		
Average blood-sugar levels:																	
(A)	.	94	. 76	72	69	66	62	63	69	77	82	87	91	94	94		
(B)	.	95	. 76	71	69	66	63	65	69	78	85	86	93	94	95		

TABLE V.—(Contd.)

Patient	Day of experiment.	Fasting blood sugar.	Minutes after injection.													
			10.	15.	20.	25.	30.	35.	40.	50.	60.	75.	90.	120.	150.	
Patient 3 :																
1 (A)	.	89	.	74	65	59	55	54	55	60	62	68	74	79	87	87
2 (B)	.	94	.	71	67	57	53	53	49	57	67	69	75	78	91	91
3 (A)	.	93	.	72	63	55	48	48	53	59	63	67	73	81	89	92
4 (B)	.	87	.	68	65	51	51	47	49	61	64	65	69	77	87	87
5 (A)	.	87	.	71	68	55	45	46	48	55	61	69	76	84	89	90
6 (B)	.	91	.	75	61	56	51	43	47	47	59	71	78	90	91	90
7 (A)	.	91	.	75	67	58	49	48	49	56	65	72	77	89	90	90
8 (B)	.	95	.	69	67	61	44	47	51	57	67	69	78	87	94	94
9 (A)	.	92	.	73	64	59	54	56	59	63	69	73	75	86	85	85
10 (B)	.	89	.	71	61	53	51	51	61	65	67	71	71	79	86	87
11 (A)	.	94	.	69	64	54	47	48	47	57	64	71	79	87	94	93
12 (B)	.	91	.	73	65	57	51	49	55	55	61	69	76	84	90	90
13 (A)	.	90	.	75	67	58	51	51	53	58	67	67	75	84	89	89
14 (B)	.	93	.	74	65	57	56	47	46	54	63	71	77	84	87	87
15 (A)	.	89	.	76	66	59	52	52	52	59	69	72	78	89	88	89
16 (B)	.	93	.	70	59	60	49	49	47	57	71	78	81	90	94	94
17 (A)	.	94	.	71	66	62	48	47	46	54	58	68	73	85	90	93
18 (B)	.	91	.	67	71	57	43	49	48	53	54	71	76	84	90	90
19 (A)	.	91	.	73	64	59	51	52	51	57	63	69	75	83	92	91
20 (B)	.	92	.	74	67	57	53	53	53	53	59	67	71	79	91	95
21 (A)	.	92	.	74	67	62	45	44	48	55	64	71	77	87	90	90
22 (B)	.	97	.	74	71	64	49	51	51	56	59	69	79	87	95	97
23 (A)	.	95	.	76	65	57	46	49	53	58	67	69	78	91	93	96
24 (B)	.	89	.	73	61	57	45	44	49	61	71	78	83	86	89	90
Average blood-sugar values :																
(A)	.	91	.	73	66	58	48	49	51	58	64	71	76	85	90	90
(B)	.	92	.	73	65	57	50	49	51	56	64	71	76	84	90	91
Patient 4 :																
1 (A)	.	84	.	63	57	47	42	41	43	48	55	67	74	83	86	86
2 (B)	.	87	.	65	63	55	48	43	42	47	57	68	69	77	81	83
3 (A)	.	90	.	69	60	53	46	45	44	51	60	71	77	85	92	93
4 (B)	.	86	.	67	59	52	47	45	44	52	59	67	81	89	89	89
5 (A)	.	88	.	65	56	47	43	41	44	47	54	67	76	89	87	87
6 (B)	.	87	.	67	55	46	43	43	43	52	63	70	77	84	86	85
7 (A)	.	91	.	71	57	50	49	49	49	54	59	65	79	85	90	90
8 (B)	.	93	.	63	59	52	45	42	47	55	57	68	79	87	92	93
9 (A)	.	87	.	65	58	52	51	50	54	59	63	69	81	87	86	85
10 (B)	.	94	.	66	57	51	46	46	47	54	64	71	78	89	93	93
11 (A)	.	90	.	63	55	52	47	45	48	54	59	70	78	89	93	94
12 (B)	.	95	.	71	61	56	51	43	47	59	63	65	80	88	96	90
13 (A)	.	91	.	67	55	50	46	46	47	55	61	72	80	83	86	89
14 (B)	.	89	.	65	59	53	41	41	44	57	59	67	75	65	90	92
15 (A)	.	93	.	70	59	52	50	51	51	53	57	64	73	85	90	92
16 (B)	.	89	.	67	53	48	46	47	48	49	63	68	79	90	92	91
17 (A)	.	87	.	71	67	56	47	48	49	52	58	67	68	77	82	87
18 (B)	.	93	.	64	59	52	49	49	49	55	63	69	72	85	85	93
19 (A)	.	88	.	65	65	57	43	46	49	53	59	67	70	70	86	86
20 (B)	.	94	.	68	57	51	47	43	54	57	58	65	61	74	87	90
21 (A)	.	90	.	61	62	49	49	48	48	56	61	68	77	76	84	90
22 (B)	.	95	.	71	59	49	49	46	45	51	59	69	79	79	85	93
23 (A)	.	91	.	63	60	53	41	43	44	49	55	66	73	73	89	92
24 (B)	.	87	.	66	63	55	45	38	39	50	59	70	73	77	81	88
Average blood-sugar values :																
(A)	.	89	.	66	59	52	46	46	47	53	58	68	76	82	88	89
(B)	.	92	.	67	59	52	46	44	46	53	60	75	75	82	88	90

patients 12 blood-sugar charts following the injection of 2 units of insulin which had been previously mixed with 100 c.c. of the patient's blood at body heat for one hour.

Results.—The results obtained are set out in detail in Table V, but the average readings of the blood-sugar levels obtained with the two kinds of injections may be summarized in Table IV.

It will be seen from Table IV that the blood-sugar values obtained in both groups, (A) and (B), are identical within the limits of the experiment. The effect on the blood sugar after 2 units of insulin have been incubated with 100 c.c. of the patient's blood at body heat for 60 minutes is of the same order as when this quantity of insulin is injected by itself. Taking the average blood volume in the adult to be 6 litres (Samson Wright, 1945), 2 units per 100 c.c. is equivalent to 120 units for the total blood volume, and were there any circulating substances in the blood ready to destroy injected insulin, it is probable that there would have been a definite neutralization of some at least of the insulin during the hour it was incubated with the blood at 37° C., with a consequent reduction of its effect upon the blood sugar following re-injection. No such diminution in activity could be found, however, as the blood-sugar values are practically identical with those obtained after the intravenous injection of 2 units of insulin in the usual way.

Conclusion.—It must, therefore, be concluded that the more temporary action of intravenous as compared with intramuscular insulin is not due to the neutralization of part of the intravenous insulin by substances already circulating in the blood stream. This conclusion, of course, does not exclude the possibility that, after insulin has been injected intravenously, a neutralizing substance might not then be poured into the blood stream to neutralize part of it, but it was not found possible in the time available to design experiments to test this possibility.

(3) *That a Portion of Intravenous Insulin is Used Up in Producing its Rapid Action on the Blood Sugar, so that Insufficient is Left to Prolong the Hypoglycaemia as is the Case with Intramuscular and Subcutaneous Insulin.*

It is well known that insulin given intravenously produces a more rapid fall in the blood sugar than when it is administered subcutaneously or intramuscularly. Sandison and McGregor (1942) also claim that patients become more easily sensitized to intravenous insulin, while several authors, e.g. Bardenat and Leonardon (1939), Reznikoff and Scott (1942) find that coma induced in this way is quieter than coma induced by the other parenteral routes. The question, therefore, arises whether there is any fundamental difference in the action of insulin when it is administered in different ways. Experiments were devised to see whether any such difference exists.

Experiment : Rate of absorption of insulin into the blood following injection.—One difference between intravenous and intramuscular injection is that by the first route all the insulin enters the blood stream almost instantaneously, whereas by the second route, a deposit of insulin is formed in the tissues, from which it is probably absorbed into the blood at a much slower rate. The

difference in action between intravenous and intramuscular insulin may, therefore, be entirely a question of *the rate at which the substance is absorbed into the blood stream.*

To test this hypothesis two patients were given insulin under the following conditions :

Increasing doses of insulin (20–132 units and 20–120 units) were added to three pints of isotonic saline and injected by intravenous drip over a period of 240 minutes. The injections were given at intervals of four days to avoid sensitization of the patient to the insulin, and blood-sugar estimations were made at 30, 60, 90, 120, 150, 180, 210, 240 and 270 minutes after the commencement of the intravenous drip. The blood-sugar results are set out in detail in Table VI, from which it will be seen that *although the insulin was given intravenously, the blood-sugar curve resembles that obtained after an intramuscular injection*, with the blood sugar reaching its lowest level in about 120 minutes after the commencement of the injection. This would seem to indicate that the apparent difference in the action of intravenous and intramuscular insulin is entirely due to the different rates at which the insulin enters the blood stream, since if insulin enters the blood by the intravenous route at a sufficiently slow rate, a blood-sugar curve of the intramuscular and not the intravenous type is produced.

To test the hypothesis further, each of three patients were then given 60, 40 and 20 units of insulin respectively as follows :

On the first morning the quantity of insulin (60, 40 or 20 units) was mixed with three pints of normal saline and given by intravenous drip over a period of 240 minutes. The patient given 60 units was therefore receiving insulin intravenously at the rate of 0.25 units per minute. The blood sugar was estimated at intervals of 15, 20, 25, 30, 35, 45, 60, 90, 120, 150, 180, 210, 240 and 270 minutes (Table VII). It was again found that although the insulin was given intravenously, the blood-sugar curve obtained was of the same type as that produced by intramuscular or subcutaneous insulin. The blood sugar reached its minimum level in 90 minutes as opposed to the usual 20–35 minutes,

TABLE VI.—*Blood-sugar Values Following Varying Doses of Insulin Given in Saline by Intravenous Drip Over 240 Minutes.*

Units of insulin.	Fasting blood sugar.	Minutes after commencement of intravenous drip.									
		30.	60.	90.	120.	150.	180.	210.	240.	270	
<i>Patient 1 :</i>											
20	. 76	. 65	56	54	38	37	39	38	38	36	
40	. 79	. 48	42	36	36	36	39	39	36	39	
60	. 81	. 65	43	32	34	27	29	32	32	36	
80	. 90	. 43	38	29	27	25	27	27	27	27	
100	. 101	. 61	39	36	27	31	29	26	26	25	
120	. 90	. 55	27	31	27	26	27	31	29	27	
132	. 92	. 47	31	29	22	24	20	19	20	24	
<i>Patient 2 :</i>											
20	. 92	. 81	74	68	63	59	54	57	54	50	
40	. 86	. 65	61	59	55	52	36	31	39	48	
60	. 98	. 74	60	58	56	45	34	28	28	36	
80	. 88	. 72	56	54	48	45	32	27	25	29	
100	. 92	. 74	57	43	32	32	27	25	27	34	
120	. 90	. 72	54	38	32	29	27	29	30	31	

TABLE VII (A).—*Blood-sugar Values Following 60 Units of Insulin Given in Saline by Intravenous Drip Over Varying Periods of Time at Intervals of Four Days.*

Column (1): Length of time in minutes over which drip was given.
Column (2): Fasting blood sugar.

Column (1).	Column (2).	Minutes after commencement of intravenous drip.														
		15.	20.	25.	30.	35.	45.	60.	90.	120.	150.	180.	210.	240.	270.	
240	98	84	80	77	72	68	63	52	26	24	24	29	25	25	32	
210	95	77	75	70	68	64	60	46	37	27	30	29	25	27	39	
195	92	73	69	63	58	56	49	38	38	32	29	29	22	25	41	
180	93	75	67	54	62	58	50	34	31	31	31	31	33	36	59	
150	92	71	68	62	58	55	49	34	33	32	32	32	32	42	57	
120	88	70	65	58	52	48	42	29	31	33	34	34	43	59	70	
90	86	70	66	59	49	52	45	31	27	29	43	50	52	66	70	
60	88	69	63	53	52	48	40	24	27	31	36	43	59	68	81	
45	86	61	54	46	38	34	28	17	22	31	43	63	74	79	75	
35	84	57	50	43	34	28	26	24	29	29	39	52	70	79	83	
20	88	62	53	54	37	32	28	29	41	49	59	63	72	79	83	
15	92	63	55	49	35	31	29	34	34	47	57	67	77	83	89	
7	92	62	53	47	39	34	28	29	31	41	50	61	74	79	83	
3	96	66	57	50	38	31	32	32	34	50	52	65	68	78	86	
0	98	67	59	51	34	34	32	32	32	42	53	59	72	74	81	

TABLE VII (B).—*Blood-sugar Values Following 40 Units of Insulin Given in Saline by Intravenous Drip Over Varying Periods of Time at Intervals of Four Days.*

Column (1): Length of time in minutes over which drip was given.
Column (2): Fasting blood sugar.

Column (1).	Column (2).	Minutes after commencement of intravenous drip.												
		25.	30.	35.	45.	60.	90.	120.	150.	180.	210.	240.	270.	
240	92	.	58			33	31	27	25	27	28	28	30	
210	88	.	70			41	35	29	33	34	33	31	34	
180	97	.	65			41	29	31	31	36	35	43	51	
150	92	.	59			46	37	36	33	33	34	36	47	
120	95	.	56			33	36	36	35	37	41	46	54	
90	96	.	58			36	31	33	41	49	52	54	65	
60	89	.	54			31	33	34	37	54	58	71	83	
45	97	.	45			27	28	33	45	67	73	84	89	
30	92	.	54	39	30	25	27	33	41	53	58	76	85	89
20	98	.	46	37	31	30	30	43	57	67	77	82	89	95
15	93	.	39	38	29	30	31	45	51	59	71	86	89	94
7	95	.	41	33	34	26	27	33	43	61	79	91	94	93
3	91	.	37	34	31	29	29	37	45	56	73	79	83	87
0	92	.	34	23	29	29	33	41	43	57	65	74	81	89

TABLE VII (C).—*Blood-sugar Values Following 20 Units of Insulin Given in Saline by Intravenous Drip Over Varying Periods of Time at Intervals of Four Days.*

Column (1): Length of time in minutes over which drip was given.
Column (2): Fasting blood sugar.

240	102	66				38	36	29	28	25	32	34	38
210	92	75				54	41	32	34	31	34	31	41
180	86	70				57	34	32	32	39	36	39	54
150	92	61				51	47	42	36	34	36	38	46
120	93	59				46	43	38	38	43	41	41	56
90	97	61				49	41	39	40	39	34	38	51
60	99	63				39	35	39	41	50	62	75	89
45	101	69				42	34	36	47	72	81	89	96
30	110	53	45	39	34	36	39	51	66	68	84	95	104
20	91	47	42	41	35	36	49	64	87	91	89	90	92
15	95	42	39	39	33	37	46	67	79	89	89	93	93
7	95	53	42	40	31	35	47	71	85	92	96	95	96
3	98	49	43	39	36	37	43	69	89	89	95	98	99
0	94	56	45	41	36	39	51	74	83	87	91	91	90

and this level was maintained until the intravenous drip was stopped after 240 minutes.

In order to minimize the effect of sensitization through daily injections of insulin, the patients were then rested for three days, and on the fourth day the experiment was repeated, but the insulin in saline was given over a period of 210 minutes. On succeeding fourth days the period over which the drip was given was progressively shortened through the following periods: 195, 180, 150, 120, 90, 60, 45, 35, 20, 15, 7, 3 and 0 minutes. At the same time the amount of normal saline with which the insulin was mixed was gradually reduced from three pints to *nil*, as the period over which it was given became progressively shorter. *It was found that as the period over which the insulin in saline was injected became shorter, so the character of the blood-sugar curve changed gradually from a typical subcutaneous curve to a typical intravenous curve.* The latter was found when 20 minutes or less were taken over the injection.

From the above results it appears that there is no fundamental difference in the action of insulin, whatever the parenteral route used to administer it. The character of the blood-sugar curve produced depends solely upon the rate at which the insulin enters the blood stream, since if intravenous insulin is given in small quantities over a long period (about 240 minutes) the blood-sugar curve is of the subcutaneous and not the intravenous type.

It remains to inquire into the mode of action of insulin injected rapidly by the intravenous route in the usual way. Why is it that intravenous insulin is unable to prolong the fall in the blood sugar, in the way that subcutaneous insulin does, so that, as we have seen, it is relatively inefficient in producing the signs of hypoglycaemia? Blood-sugar curves following intravenous insulin differ from those obtained with subcutaneous insulin mainly in the more rapid and profound fall in the blood sugar. Whereas with subcutaneous insulin the maximum fall in the blood sugar occurs about 90 minutes after the injection, with intravenous insulin the maximum fall is reached in 20–35 minutes, the exact time depending on the amount of insulin injected. In addition, the fall after intravenous insulin is always more profound than that after intramuscular insulin, although this fall cannot be maintained.

We have, therefore, to consider the relationship between the amount of insulin injected and (1) the *extent* of the fall in the blood sugar and (2) the *rate* of this fall.

If the curve of the graph of the relationship is a *rectangular hyperbole*, as shown below, then, since $xy = c$, small doses of insulin will cause a considerable initial fall in the blood sugar, but further decreases can only be achieved by the expenditure of increasingly large doses of insulin until a point is reached when further increases in the amount of insulin, no matter how large, are unable to reduce the blood sugar any further. Considerably more insulin will be required to produce the more intense falls in the blood sugar. *A portion at least of the insulin would be used up in producing the intense fall, and would be unavailable for prolonging the fall in the blood sugar which is necessary for the development of the more pronounced signs of hypoglycaemia, so that a greater quantity of insulin would be required to produce these pronounced effects than would be required by the intramuscular or subcutaneous route.*

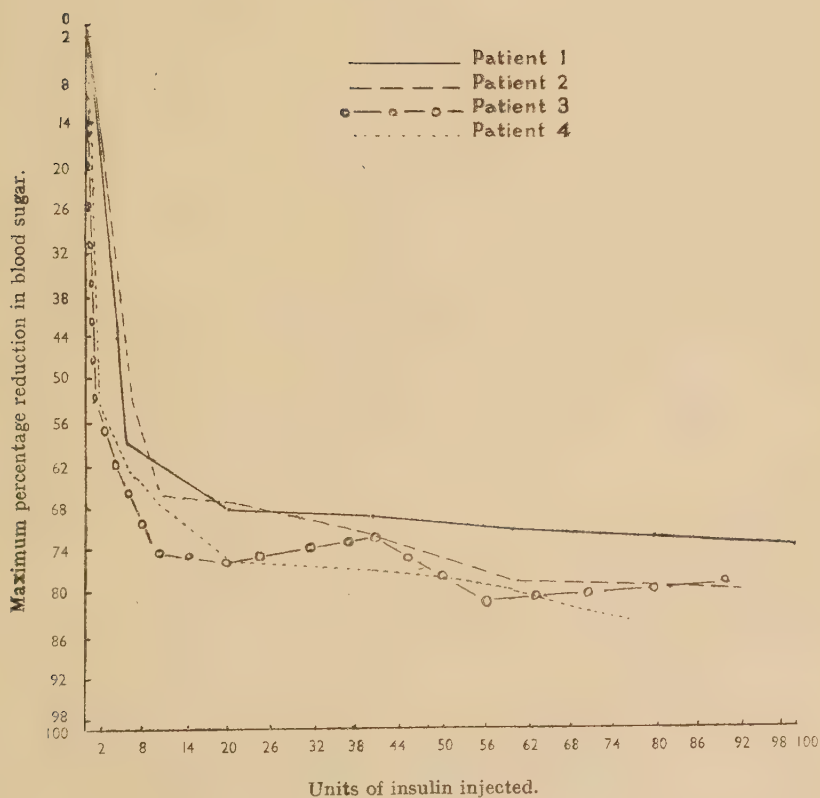
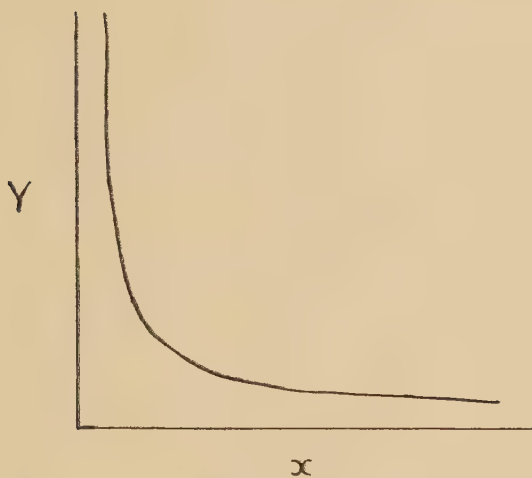
Experiments were then designed to find the relationship between the amount of insulin injected and the extent and rate of the fall in the blood sugar.

(1) *The Relationship Between the Amount of Insulin Injected and the Extent of the Consequent Fall in the Blood Sugar.*

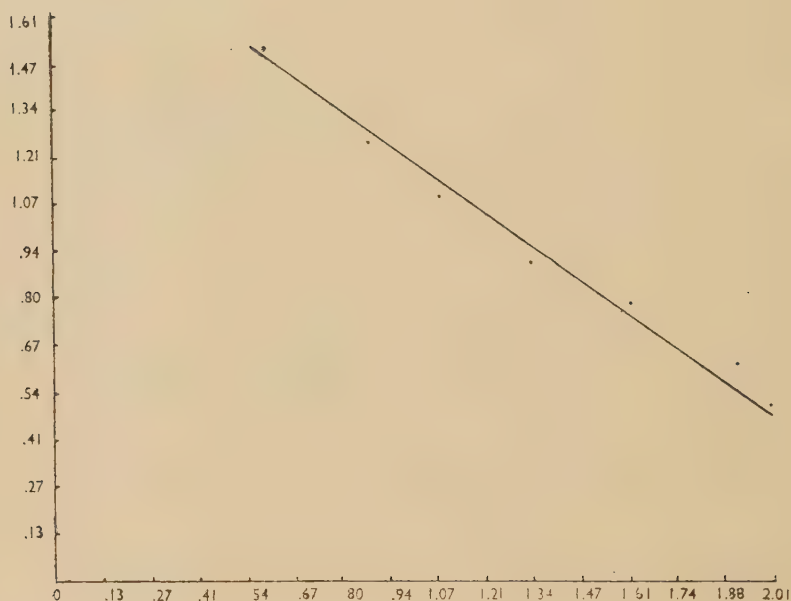
Four patients were given increasing doses of insulin from 2-170 units at 4-day intervals to avoid sensitization, and the minimum blood value obtained with each dose was noted. From this value the percentage fall in the blood sugar was calculated. The results are given in detail in Table VIII, and from this a graph (Graph 1) was prepared for each patient in which the percentage fall in the blood sugar (ordinate (y)) was placed against the number of units of insulin injected (abscissa (x)). The graph has to be interpreted in the light of the conditions of the experiment, especially that of the patients' diet, which did not have a constant carbohydrate content as the patients ate as much as they wished (Himsworth, 1939). It will be seen, however, that the general form of the curves of the graph resembles that of a rectangular hyperbole. In Patient 4, for instance, 2 units of insulin produced an initial fall of 52 per cent. in the blood sugar, but 6 units ($3x$) produced a fall of only 62 per cent. ($1.2x$); 10 units ($5x$), a fall of 67 per cent. ($1.3x$); and 20 units ($10x$), a fall of 75 per cent. ($1.4x$). In general, the maximum fall of 70-80 per cent. was achieved by 10 units, after which the curve almost completely flattened out, so that high multiples of the original 2 units, which produced an initial fall of 52 per cent., were eventually required to produce a fall of a few milligrams per cent.

TABLE VIII.—*Minimum Blood-sugar Values Obtained with Increasing Doses of Intravenous Insulin.*

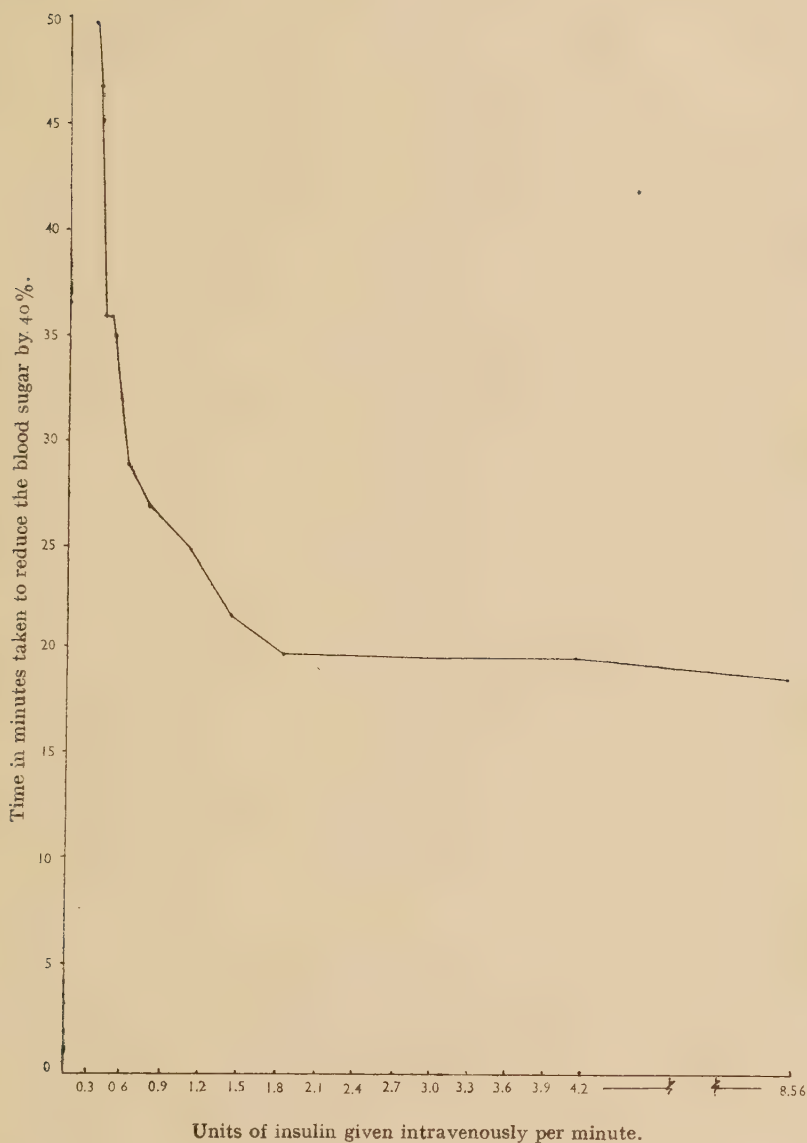
Units of insulin.	Fasting blood sugar.	Minimum blood sugar obtained.	Percentage reduction in blood sugar.	Units of insulin.	Fasting blood sugar.	Minimum blood sugar obtained.	Percentage reduction in blood sugar.
<i>Patient 1:</i>				<i>Patient 2:</i>			
2	97	54	44	2	94	63	33
6	101	41	59	6	89	42	55
10	95	36	62	10	91	31	66
20	106	34	68	20	75	25	67
40	108	34	69	40	79	22	72
60	92	27	71	60	92	19	79
80	97	27	72	80	95	19	80
100	99	27	73	86	89	21	76
120	88	23	74	92	93	19	80
140	102	28	73	100	101	19	81
160	94	25	73	110	99	15	85
170	96	25	74	118	95	17	82
<i>Patient 3:</i>				<i>Patient 4:</i>			
2	97	46	53	2	98	47	52
6	94	31	67	6	93	35	62
10	101	27	74	10	97	32	67
20	95	24	75	20	115	29	75
40	99	29	72	40	100	23	77
56	97	17	82	52	97	21	78
68	102	20	80	60	95	19	80
80	115	23	80	68	108	19	82
92	97	20	79	76	117	17	85
104	108	19	82	—	—	—	—
114	96	21	78	—	—	—	—



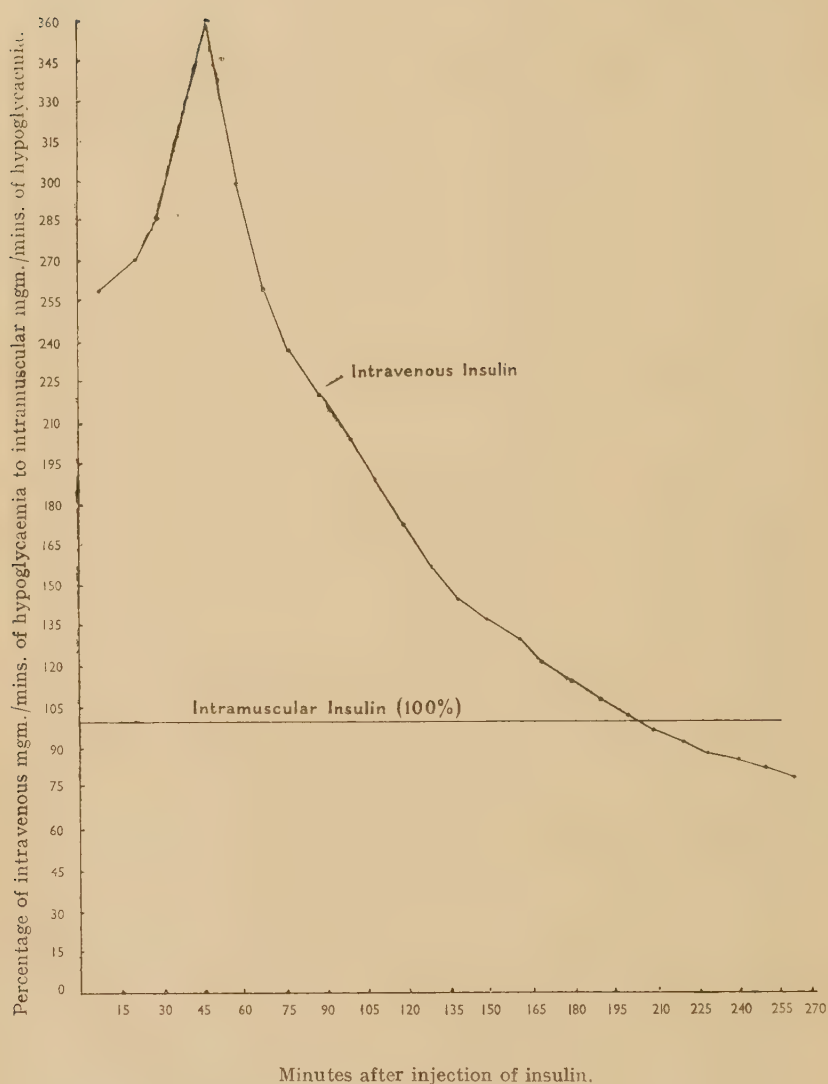
GRAPH I.—Relationship between the amount of insulin injected and the extent of the fall in the blood sugar. (Compiled from Table VIII.)



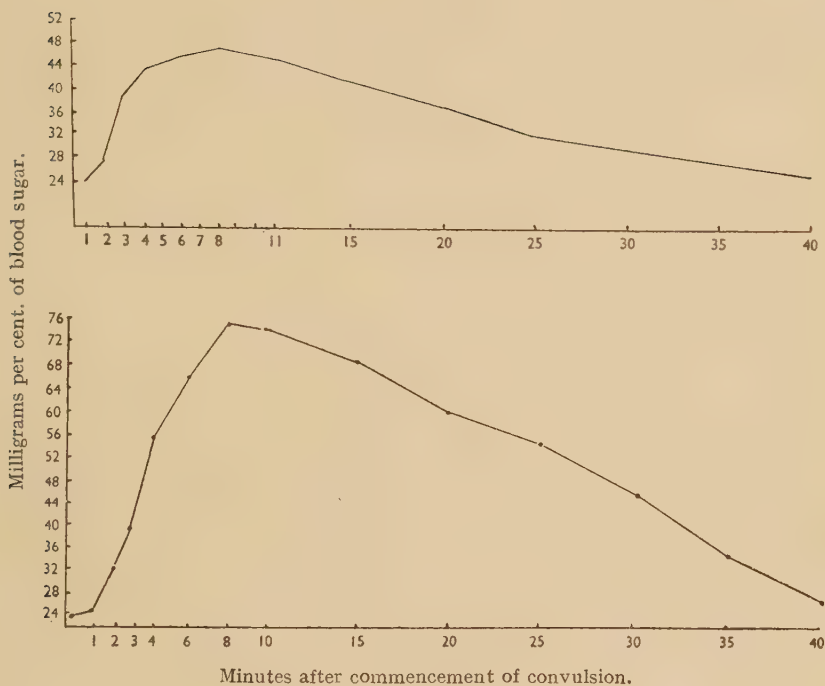
GRAPH 2.—Curve of the graph of $\log(x + a)$ against $\log(y - b)$.



GRAPH 3.—Times taken by varying amounts of intravenous insulin to reduce the blood sugar by 40%. (Compiled from Table X.)



GRAPH 4.—Mgm./mins. of hypoglycaemia at varying times after intravenous injection of insulin expressed as the percentage of mgm./mins. of hypoglycaemia produced by intramuscular insulin at the same times after injection. (Compiled from Table XI.)



GRAPH 5.—The upper figure shows the behaviour of the blood sugar following a spontaneous insulin convulsion; the lower figure shows the behaviour of the blood sugar following a phrenazol convulsion induced during hypoglycaemia.

Taking the curve of Patient 1 in detail, the following table can be constructed :

$x = 2$	6	10	20	40	60	80	100
$y = 44$	59	62	68	70	71	72	73

Changing y into $100-y$ so as to make both axes start at zero, we get—

$x = 2$	6	10	20	40	60	80	100
$y = 56$	41	38	32	30	29	28	27

$xy = c$ can also be rendered $\log (x + a) + \log (y - b) = C$. If there is any relationship of this latter form in the above table, i.e. if the original curve is a rectangular hyperbole, the curve of the graph of $\log (x + a)$ against $\log (y - b)$ would be a straight line.

For this particular curve it is reasonable to make $a = 2$ and $b = 24$. This leads to the table :

$x + 2 = 4$	8	12	22	42	62	82	102
$y - 24 = 32$	17	14	8	6	5	4	3

Expressing this table in logarithms we get :

$\log (x + 2) =$	·60	·90	1·08	1·34	1·62	1·79	1·91	2·01
$\log (y - 24) =$	1·51	1·23	1·15	·90	·78	·70	·60	·48

This is plotted in Graph 2 and the fit of the observed points to the line is good.

Owing to the difficulty in giving a biological meaning to the variables in the fitting of a hyperbolic curve, it is not claimed that the above curve shows anything more than consistency with the view that profound falls in the blood sugar can only be achieved by the use of disproportionately large doses of insulin *which are used up in producing the fall*. This result is in agreement with Himsworth's (1939) conception of the "head of pressure" nature of the blood sugar. The more profound the fall in the blood sugar, the more serious is the effect upon the metabolism of the tissues. A 10 per cent. fall from an already low blood sugar of 40 per cent. to 30 per cent. has much more serious effect on the tissues than an equal fall from 80 per cent. to 70 per cent. Therefore the more profound the fall the greater will be the activity of the anti-insulin mechanism to prevent any further fall, so that the more the blood sugar is reduced, the greater the amount of insulin required to reduce it still further.

(2) *The Relationship Between the Amount of Insulin Injected and the RATE of the Consequent Fall in the Blood Sugar.*

This relationship was deduced from the results obtained by injecting 60 units of insulin in saline over varying periods from 240-0 minutes (Table VII). Owing to the variation in the fasting blood levels, the blood-sugar values obtained in this experiment were recalculated as percentages of the fasting blood-sugar values, and these percentages are set out in Table IX. From this table was then calculated the *time*, in minutes, taken by increasing doses of insulin (0·25-8·56 units of insulin per minute) to reduce the fasting blood sugar

by the arbitrarily chosen amount of 40 per cent. The results of the calculation are given in Table X and in graph form in Graph 3. It will be seen that as with the relationship between the amount of insulin injected and the *extent* of the fall in the blood sugar, so the relationship between the amount of insulin and the *rate* of the fall in the blood sugar is of the rectangular hyperbole type. From the graph we find that 0.25 units of insulin will reduce the blood sugar by 40 per cent. in 50 minutes. To reduce it to this figure in 25 minutes ($2x$) not 0.5 units, but 1.0 units ($4x$) is required. To reduce it in 20 minutes ($2.5x$), 1.71 units ($7x$) are required. After 1.71 units per minute the curve flattens out, so that very large increases of insulin are required to reduce the blood sugar by 40 per cent. in 19 minutes (8.56 units per minute), after which further increases, however large, are unable to reduce the time beyond this minimum. It follows, therefore, that increase in the rate at which the blood sugar is reduced can only be achieved by the expenditure of *disproportionately large quantities of insulin which are used up in the production of the increased rate of fall.*

The relationship between the amount of insulin injected and the *extent* and *rate* of the consequent fall in the blood sugar have been considered separately, and the graphs of both relationships have been shown to be of the rectangular hyperbole type. In practice, of course, the relationships cannot be so separated, since the amount of insulin injected influences both the extent and rate of the fall in the blood sugar simultaneously; but the fact that the graph of each relationship is of the rectangular hyperbole type indicates that when the extent and rate are influenced simultaneously, still more disproportionately large amounts of insulin will be required to, say, double the percentage fall in the blood sugar in half the time.

From the above experiments and calculations it follows that as a proportion of insulin injected intravenously is used up in producing the rapid, profound fall in the blood sugar which follows this mode of administration, insufficient insulin is left to prolong the hypoglycaemia at a sufficiently low level for coma to ensue. In this connection it may be pointed out that as long ago as 1930 Nordsted, Norgaard and Thaysen (1930) found a lag between the fall in the blood sugar and the development of even mild hypoglycaemia symptoms. Signs of hypoglycaemia could even develop as the blood sugar was returning to normal. This time lag is due, of course, to the fact that the tissues themselves have to be deprived of glucose before the signs of hypoglycaemia can develop, and this deprivation does not occur immediately the blood sugar falls, but some time afterwards. Freudenberg (1938) and Freudenberg and Fine (1940) pointed out that the blood sugar had to be maintained below 30 mgm. per cent. for about 90 minutes before unconsciousness would ensue, and for about 200 minutes before the corneal reflexes would disappear. In assessing the efficacy of any method of administering insulin in the production of hypoglycaemic symptoms it is necessary, therefore, to have regard as much to the time during which the level of the blood sugar can be depressed as to extent and rate of the initial fall in the blood sugar, since unless a profound and rapid initial fall can be maintained for a sufficient length of time, hypoglycaemic symptoms will be less than with a smaller, less rapid fall maintained for a longer period.

TABLE IX.—*Percentage Reduction in Blood Sugar Following 60 Units of Insulin Given in Saline by Intravenous Drip Over Varying Periods of Time at Intervals of Four Days. (Compiled from Table VII (A).)*

Column (1): Units of insulin injected per minute during intravenous drip.

Column (2): Length of time in minutes over which drip was given.

Column (3): Fasting blood sugar.

Column (1).	Column (2).	Column (3).	Minutes after commencement of intravenous drip.															
			15.	20.	25.	30.	35.	45.	60.	90.	120.	150.	180.	210.	240.	270.		
0.25	240	98	16	18	21	26	30	35	47	73	75	75	70	74	74	67		
0.29	210	95	19	23	26	28	33	37	51	61	71	68	69	73	71	59		
0.31	195	92	21	25	31	37	39	47	58	58	65	68	68	76	73	55		
0.33	180	93	19	28	31	32	38	46	63	67	67	67	67	65	61	37		
0.40	150	92	23	26	32	37	40	47	63	64	65	65	65	65	54	38		
0.50	120	88	20	26	34	41	46	52	67	65	63	61	61	51	33	20		
0.67	90	86	18	23	31	46	40	48	64	69	66	50	42	39	23	19		
1.00	60	88	22	28	39	41	45	55	73	69	65	59	51	33	23	8		
1.33	45	86	29	37	47	56	61	67	80	74	64	50	27	14	8	13		
1.71	35	84	32	40	49	60	67	69	71	66	66	54	38	15	6	1		
3.00	20	88	29	40	39	58	64	68	67	53	44	33	28	18	10	5		
4.00	15	92	31	40	47	62	66	68	63	63	49	39	27	16	10	3		
8.56	7	92	32	42	48	58	63	70	68	66	55	46	34	20	14	10		
20.00	3	96	31	41	48	60	68	67	67	65	48	46	33	29	20	10		
60.00	0	98	32	31	48	65	65	67	67	67	47	46	40	27	24	17		

TABLE X.—*Length of Time Taken by Varying Amounts of Insulin to Reduce the Blood Sugar by 40 mgm. per cent. Calculated from Table IX above.*

Column (1): Units of insulin injected per minute.

Column (2): Length of time taken by given amount of insulin to reduce the blood sugar by 40 mgm. per cent.

Column (1).	Column (2).	Column (1).	Column (2).
0.25	50	1.0	25
0.29	47	1.33	22
0.31	36	1.71	20
0.31	36	3.00	20
0.40	35	4.00	20
0.50	29	8.50	19
0.67	27	20.00	19

The hypothesis that a portion of insulin given intravenously is used up in producing the rapid and profound fall in the blood sugar indicated by the above experiments on the relationship between the amount of insulin injected and the extent and rate of the fall in the blood sugar would, therefore, be confirmed if it could be shown that the total amount of hypoglycaemia produced by a given quantity of intravenous insulin is less than that produced by the same quantity of intramuscular insulin.

It is necessary, therefore, to determine the power of intravenous and intramuscular insulin to produce hypoglycaemia in relation to the time over which it is produced, since the duration of the action is as important as its intensity. Unfortunately, there is no unit of "the degree $\times$ the duration of hypoglycaemia" available, and it is usual to express this quantity in terms of milligram/minutes of hypoglycaemia. If the same dose of insulin is injected first intramuscularly and then intravenously on separate occasions, from the blood-sugar curves obtained following the injection it is possible to calculate the milligram/minutes of hypoglycaemia produced over any desired period, and the two methods of injection can be compared with respect to the total milligram/minutes of hypoglycaemia produced before the blood sugar returns to normal.

Experiment.—The blood-sugar curves obtained from Patient 1 (Table II) following the injection of 20 units of insulin intramuscularly and intravenously were investigated and the total milligram/minutes of hypoglycaemia produced after 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, 150, 160, 170, 180, 190, 200, 210, 220, 230, 240, 250, 260 and 270 minutes from the time of the injection was calculated. The results are set out in detail in Table XI, from which it will be seen that for some time after the injection, intravenous insulin produces very many more milligram/minutes of hypoglycaemia, but that later it fails to hold this lead, and ultimately is surpassed by the intramuscular insulin. For example, after 10 minutes intravenous insulin has produced 255 per cent. more milligram/minutes of hypoglycaemia than the intramuscular insulin. This preponderance reaches its highest level at 360 per cent. after 50 minutes, following which it steadily declines, so that each method has produced approximately the same number of milligram/minutes of hypoglycaemia after 210 minutes, and after 270 minutes the intramuscular insulin has actually produced 21 per cent. more than the intravenous. As Sakel's treatment is not usually given for longer periods than about five hours each day, the experiment was terminated at 270 minutes, before the blood sugar following intramuscular insulin has returned to normal. Had the experiment been continued until the intramuscular blood sugar had returned to normal, the superiority of intramuscular over intravenous insulin in terms of total milligram/minutes of hypoglycaemia would have been even more striking.

From the percentages of "intravenous milligram/minutes of hypoglycaemia to intramuscular milligram/minutes of hypoglycaemia" given in Table XIV, the graph of Graph 4 has been constructed. This brings out the conclusion noted above that intravenous insulin is more efficient for some time after the injection, but less efficient later on than intramuscular insulin in terms of production of milligram/minutes of hypoglycaemia. From this early superiority of intravenous insulin, it follows that insulin given in this way may be more efficient than intramuscular insulin in producing the milder degrees of hypoglycaemia, such as sweating, pallor, etc., but its later inferiority shows that it will be less efficient in producing the more pronounced degrees of hypoglycaemia, such as coma according to Wilson's (1937) standard. It has already been pointed out that different authors have varying standards of coma, and it is possible that some authors, e.g. Sandison and McGregor (1942), have found that a smaller dose of intravenous as compared with subcutaneous insulin would induce coma because their standard of coma has been a light one, whereas, had they adopted Wilson's (1937) standard of complete areflexia, they would have found that a larger dose was required. That this is probably so is shown by Table III, from which it will be seen that slightly smaller doses of intravenous than intramuscular insulin will induce "sopor" (unconsciousness), whereas considerably larger doses are required to produce coma with Babinski plantar responses and absent corneal reflexes.

The conclusions which may be drawn from the experimental work described so far will be summarized fully later. It may be stated briefly here that the value of intravenous insulin in Sakel's hypoglycaemic coma depends upon the depth of coma which the therapist wishes to produce. If it is desired only to

produce hypoglycaemic unconsciousness, the intravenous insulin is preferable to intramuscular as a smaller dose is required, and with the more rapid return of the blood sugar to normal the danger of post-hypoglycaemic coma developing is diminished. If, however, the considerably deeper hypoglycaemic state

TABLE XI.—*Milligram/Minutes of Hypoglycaemia Produced by 20 Units of Intramuscular and Intravenous Insulin.*

Blood-sugar curve (Table II, Patient 1) :

	Fasting blood sugar.	Minutes after injection.													
		25.	30.	35.	40.	50.	60.	75.	90.	120.	180.	10.	210.	240.	270.
I.M.	75		56				47		50	47	50	48	47	54	54
I.V.	83	38	29	31	25	30	38	45	53	66	72	81	81	83	83

Minutes after injection of insulin.	Total milligram/minutes of hypoglycaemia produced :—		Percentage of intravenous mgm./mins. of hypoglycaemia to intramuscular mgm./mins. of hypoglycaemia.
	Intravenously.	Intramuscularly.	
10	88	35	262
20	361	133	272
30	810	280	289
40	1348	479	282
50	1864	516	360
60	2353	781	300
70	2781	1056	262
80	3158	1321	239
90	3486	1576	220
100	3762	1831	206
110	3986	2094	191
120	4074	2367	172
130	4132	2640	157
140	4271	2905	147
150	4389	3160	139
160	4481	3413	131
170	4544	3670	124
180	4577	3937	116
190	4597	4207	109
200	4617	4482	103
210	4637	4760	97
220	4654	5025	93
230	4665	5272	89
240	4668	5296	87
250	4668	5506	85
260	4668	5716	82
270	4668	5926	79

of coma with areflexia is required, then intravenous insulin has no advantage over intramuscular insulin, as a larger dose is required to maintain the blood sugar at a sufficiently low level for the long period necessary, and the possibility of prolonged coma developing remains the same. In view of this it was decided to determine whether any of the "prolonged" insulins, such as protamine insulin and protamine zinc insulin, had any advantage over ordinary soluble insulin when given intravenously.

Intravenous Protamine and Protamine Zinc Insulin.

Polatin and Spotnitz (1942a) found that there was less tendency for patients to develop after-shock on protamine zinc insulin intravenously than on ordinary soluble insulin given by the same route, and Hinko *et al.* (1941) found that intradermal sensitivity tests were less marked with protamine zinc insulin than with soluble insulin in a patient who had previously developed an anaphylactic shock following subcutaneous injection of soluble insulin. Longwell

and Ravin (1936) in animal experiments could find no difference in the action of soluble insulin and protamine insulin when these were given intravenously. Protamine zinc insulin was used intravenously in Sakel's treatment by McGregor and Sandison (1940) and Sandison and McGregor (1942), who found that there was neither particular advantage nor particular danger in its use.

Protamine insulin and protamine zinc insulin have not been given intravenously more frequently, probably owing to the fact that they are suspensions and that, therefore, the possibility of embolism cannot be overlooked. Hagedorn *et al.* (1936) showed that protamine insulin is soluble in serum to the extent of 50 units per c.c. of serum, and attributed the solubility to the presence of protein. The solubility in water or salt solution is very much less—about 0.5 unit per c.c. The danger of embolism on intravenous use does not, therefore, arise. No work, however, appears to have been published on the solubility of protamine zinc insulin, and so before this type of insulin was given intravenously, the following experiment was carried out:

Experiment.—10 c.c. of blood were collected from each of six patients and 2 c.c. of the serum from each specimen were separated and placed in a test-tube. Protamine zinc insulin was then added to the serum and was found to dissolve in it. The upper limit of solution was about 50 units per c.c. of serum, beyond which a slight turbidity developed. It will be seen, therefore, that the solubility of protamine zinc insulin in serum is of the same order as that of protamine insulin. The exact chemistry of the solution of protamine insulin has not been worked out, but the chemistry of the solution of protamine zinc insulin is almost certainly the same, and is probably analogous to the protective effect of protein on colloidal suspensions (Trevan, 1941, 1946). As 50 units of protamine zinc insulin per c.c. of serum is roughly equivalent to 300,000 units for the 6 litres of total blood in the body, it is obvious that no danger of embolism is likely to arise from the doses usually used in Sakel's treatment.

In view of the results of the above experiments and of the work of Hagedorn *et al.* (1936), 6 of the patients who had previously been given comparative doses of intravenous and intramuscular insulin (Table II) were divided into two groups. The first 3 were given the same doses of protamine insulin intravenously as they had previously received of soluble insulin intravenously. In the case of the remaining 3 patients protamine zinc insulin was given under similar circumstances in place of the protamine insulin. The blood-sugar values obtained following the injections are set out in detail in Tables XII and XIII, from which it will be seen that both protamine and protamine zinc insulin have the same effect on the blood sugar as ordinary soluble intravenous insulin has. There was also no difference between the patients' clinical response to the various kinds of insulin. The delayed action insulins, therefore, do not appear to possess any advantage over soluble insulin when given intravenously.

Summary of Conclusions from Experimental Work.

(1) More intravenous insulin than intramuscular insulin is required to induce the profound hypoglycaemic state of coma with areflexia in Sakel's treatment.

TABLE XII.—*Blood-sugar Values Following (A) Increasing Doses of Soluble Insulin Intravenously and (B) Increasing Doses of Delay (Protamine) Insulin Intravenously to Test their Comparative Effects.*

Patient	Units of insulin.	Fasting blood sugar.	Minutes after injection.														
			25.	30.	35.	40.	50.	60.	75.	90.	120.	150.	180.	210.	240.	270.	
Patient 1:																	
20 (A)	.	83	.	38	29	31	25	30	38	45	43	66	72	81	81	83	83
20 (B)	.	90	.	51	42	30	30	29	40	47	57	67	75	85	87	87	88
40 (A)	.	90	.	34	30	32	29	32	33	35	39	48	59	70	78	79	79
40 (B)	.	86	.	47	34	33	30	30	30	34	41	46	57	70	79	79	78
60 (A)	.	78	.	42	37	35	32	37	38	42	47	54	64	66	76	78	78
60 (B)	.	88	.	36	31	30	33	35	40	40	41	49	63	70	77	75	74
80 (A)	.	88	.	39	31	31	25	24	29	32	39	37	56	72	83	85	87
80 (B)	.	91	.	51	43	43	32	32	28	29	30	43	57	68	75	83	84
100 (A)	.	92	.	35	27	23	23	22	29	31	33	41	45	47	56	67	71
100 (B)	.	87	.	32	32	26	27	27	25	34	34	38	38	38	49	62	68
120 (A)	.	88	.	24	22	22	20	24	27	25	29	29	36	38	45	56	64
120 (B)	.	91	.	39	21	19	22	26	26	26	30	29	29	36	47	60	69
140 (A)	.	77	.	39	43	24	22	27	34	30	34	32	32	35	44	49	55
140 (B)	.	83	.	51	34	22	23	23	24	24	37	39	39	41	41	47	58
160 (A)	.	78	.	44	46	43	27	24	31	27	36	39	36	37	42	43	41
160 (B)	.	85	.	36	36	32	19	25	27	27	33	35	36	38	40	41	41
174 (A)	.	83	.	56	35	32	25	19	18	20	24	26	28	29	30	29	28
174 (B)	.	81	.	39	31	23	23	20	18	21	25	25	23	26	26	27	27
Patient 2:																	
20 (A)	.	106	.	57	47	41	36	34	41	45	54	75	95	90	92	93	102
20 (B)	.	98	.	47	41	37	34	35	38	46	55	73	88	94	94	94	96
40 (A)	.	108	.	65	54	34	41	39	43	47	47	66	77	86	96	95	95
40 (B)	.	99	.	45	44	31	37	41	41	43	45	61	69	84	89	90	90
60 (A)	.	92	.	56	50	41	32	32	32	37	32	35	43	63	72	81	87
60 (B)	.	97	.	75	63	34	34	33	34	32	32	31	38	65	75	83	90
80 (A)	.	97	.	56	45	38	31	32	36	32	32	38	46	55	61	75	83
80 (B)	.	102	.	61	34	42	36	33	33	39	39	41	48	48	59	63	76
100 (A)	.	86	.	63	48	31	36	27	27	24	27	38	38	47	53	70	77
100 (B)	.	93	.	47	45	33	31	30	30	30	30	21	32	39	49	61	72
120 (A)	.	88	.	77	61	34	32	32	31	36	33	35	36	41	49	61	68
120 (B)	.	95	.	56	45	31	33	35	35	37	35	35	35	39	39	54	54
140 (A)	.	102	.	72	66	59	45	34	34	32	31	34	38	42	48	58	64
140 (B)	.	95	.	56	47	45	43	31	35	35	36	37	37	37	45	61	67
160 (A)	.	94	.	60	48	34	30	30	31	31	31	33	35	36	40	46	44
160 (B)	.	98	.	70	55	49	31	28	28	30	35	34	33	35	39	39	47
170 (A)	.	96	.	55	44	34	29	31	29	32	25	31	29	32	29	31	33
170 (B)	.	97	.	47	32	20	19	17	28	28	32	31	27	25	20	27	28
Patient 3:																	
20 (A)	.	75	.	32	27	25	25	27	29	27	34	55	63	75	83	80	79
20 (B)	.	81	.	56	35	29	30	27	30	33	37	49	59	79	80	84	86
40 (A)	.	79	.	44	34	27	22	22	24	24	29	33	47	66	72	79	79
40 (B)	.	83	.	49	41	33	25	21	21	21	30	31	39	54	69	76	76
60 (A)	.	92	.	32	28	24	19	19	22	27	25	30	43	54	63	74	88
60 (B)	.	88	.	35	33	22	20	18	19	25	23	25	39	57	57	67	79
80 (A)	.	95	.	36	29	29	19	19	19	25	24	24	29	36	47	68	74
80 (B)	.	87	.	45	20	25	22	22	27	29	32	32	32	32	44	59	69
86 (A)	.	89	.	45	31	30	22	21	20	22	23	23	26	27	46	57	69
86 (B)	.	92	.	51	35	35	27	29	30	29	29	30	36	45	54	61	72
92 (A)	.	93	.	38	30	22	23	21	20	19	21	25	27	26	43	54	63
92 (B)	.	92	.	41	29	21	19	18	23	24	22	23	23	31	39	57	—
100 (A)	.	101	.	36	32	24	24	24	19	19	20	22	27	36	39	47	59
100 (B)	.	95	.	33	27	21	21	25	23	23	23	23	24	29	38	49	54
110 (A)	.	99	.	34	24	22	15	15	19	15	19	21	30	29	34	36	43
110 (B)	.	98	.	43	31	23	20	19	17	19	21	23	27	27	26	39	47
118 (A)	.	95	.	32	29	24	18	18	17	18	20	22	21	25	27	26	29
118 (B)	.	97	.	31	35	21	20	18	17	20	23	24	24	23	23	27	31

(2) Less intravenous insulin than intramuscular insulin is required to produce the milder hypoglycaemic symptoms, such as perspiration and unconsciousness.

(3) Insulin given intravenously in Sakel's treatment is—

(a) Not excreted by the kidneys.

(b) Not neutralized by circulating substances in the blood.

TABLE XIII.—*Blood-sugar Values Following (A) Increasing Doses of Soluble Insulin Intravenously and (B) Increasing Doses of Protamine Zinc Insulin to Test their Comparative Effects.*

Patient	Units of insulin.	Fasting blood sugar.	Minutes after injection.														
			25.	30.	35.	40.	50.	60.	75.	90.	120.	150.	180.	210.	240.	270.	
Patient 1:																	
20 (A)	.	108	. 72	48	36	34	31	31	45	47	66	86	90	93	95	98	
20 (B)	.	98	. 67	51	34	33	32	34	46	51	67	79	88	94	98	99	
40 (A)	.	95	. 45	32	29	20	15	20	22	22	48	54	68	75	75	83	
40 (B)	.	97	. 51	34	32	22	19	22	23	24	44	57	71	79	86	86	
60 (A)	.	90	. 36	27	24	20	25	27	22	34	47	55	58	59	71	83	
60 (B)	.	93	. 43	31	26	21	23	23	24	29	41	56	56	60	72	79	
80 (A)	.	88	. 57	39	32	24	22	24	25	25	26	24	41	54	70	75	
80 (B)	.	91	. 51	40	28	25	22	26	28	30	31	31	38	51	67	72	
90 (A)	.	93	. 43	35	34	29	26	26	32	30	29	34	36	41	49	56	
90 (B)	.	95	. 55	50	30	28	24	23	24	31	34	36	38	38	52	59	
98 (A)	.	101	. 60	54	33	32	25	24	31	29	23	33	36	38	41	41	
98 (B)	.	94	. 43	42	28	29	28	27	32	34	34	36	36	38	45	44	
110 (A)	.	96	. 54	40	32	29	25	23	24	25	23	26	28	34	37	39	
110 (B)	.	96	. 50	32	29	27	26	26	27	24	24	27	27	31	36	41	
118 (A)	.	86	. 65	54	39	32	22	18	14	15	15	17	15	16	18	—	
118 (B)	.	93	. 55	41	27	27	24	20	18	21	17	18	19	17	17	17	
Patient 2:																	
20 (A)	.	95	. 43	31	29	31	24	26	31	38	47	59	80	93	93	94	
20 (B)	.	93	. 56	44	31	29	26	28	33	41	46	57	73	81	85	89	
40 (A)	.	99	. 34	32	29	31	31	36	41	41	43	54	71	78	82	93	
40 (B)	.	91	. 43	37	30	28	28	41	45	45	49	56	69	77	77	87	
56 (A)	.	97	. 27	24	23	17	20	25	32	33	34	37	37	41	56	67	
56 (B)	.	98	. 39	22	24	20	26	19	27	27	36	39	40	47	63	65	
68 (A)	.	102	. 43	30	25	20	27	25	28	33	31	34	36	40	45	52	
68 (B)	.	97	. 51	41	29	27	23	29	31	35	39	41	43	51	51	49	
80 (A)	.	115	. 34	31	27	25	23	25	36	31	34	39	38	41	41	43	
80 (B)	.	98	. 37	29	26	27	25	25	29	29	35	36	37	38	38	39	
92 (A)	.	97	. 39	34	—	26	31	27	31	31	25	32	30	31	33	37	
92 (B)	.	100	. 51	41	27	26	24	23	23	29	36	29	28	28	33	35	
104 (A)	.	108	. 34	31	35	24	19	25	27	25	26	29	31	29	33	33	
104 (B)	.	94	. 76	34	23	18	18	24	23	27	27	27	27	32	35	36	
114 (A)	.	96	. 27	29	25	22	27	25	24	22	21	23	25	22	20	20	
114 (B)	.	97	. 41	28	20	19	18	17	23	25	24	23	23	23	21	22	
Patient 3:																	
20 (A)	.	108	. 48	39	25	32	27	32	33	36	43	50	74	87	93	97	
20 (B)	.	101	. 72	41	23	25	26	34	35	38	45	46	67	77	81	93	
40 (A)	.	106	. 57	45	39	27	29	24	25	27	31	51	72	83	95	92	
40 (B)	.	103	. 49	43	38	30	24	26	29	32	39	55	69	79	93	93	
60 (A)	.	106	. 50	39	29	29	29	27	31	24	34	52	63	75	89	94	
60 (B)	.	99	. 51	37	27	26	25	33	35	34	37	49	65	73	87	91	
80 (A)	.	105	. 59	47	38	32	24	22	24	19	22	31	44	36	48	54	
80 (B)	.	106	. 44	34	31	39	27	27	25	23	23	29	39	47	51	56	
92 (A)	.	111	. 48	31	24	24	19	15	20	20	27	36	32	36	36	43	
92 (B)	.	98	. 61	35	21	33	20	21	21	24	25	34	37	37	39	41	
100 (A)	.	96	. 50	41	27	24	22	23	24	34	27	28	30	34	35	35	
100 (B)	.	104	. 46	27	26	20	23	25	27	27	29	29	33	33	33	37	
110 (A)	.	112	. 43	29	25	29	31	25	22	25	32	29	32	34	29	29	
110 (B)	.	107	. 72	33	31	23	23	23	27	25	26	27	35	37	37	34	
118 (A)	.	101	. 45	20	19	19	17	20	19	19	20	22	25	24	28	30	
118 (B)	.	105	. 51	31	21	23	19	16	17	17	23	24	24	23	24	26	

(4) The varying efficiency of intravenous insulin in producing the different degrees of hypoglycaemia is due to the fact that the rapid, profound fall in the blood induced by intravenous insulin cannot be maintained, as the slower, less profound fall which follows the subcutaneous injection of insulin can be. A portion of insulin given intravenously is used up in producing the rapid, profound fall in the blood sugar, and so ultimately the total milligram/minutes of hypoglycaemia produced by intravenous insulin, following an early superiority, is less than that produced by intramuscular insulin.

(5) (a) The curve of the graph of the relationship between the amount of insulin injected and the *extent* of the consequent fall in the blood sugar is a rectangular hyperbole.

(b) The curve of the graph of the relationship between the amount of insulin injected and the *rate* of the consequent fall in the blood sugar is also a rectangular hyperbola.

Therefore the rapid, profound fall in the blood sugar following intravenous insulin can only be produced by the using up of a portion of the insulin, which is, therefore, unavailable for the maintenance of the blood sugar at the necessary low level for the required period of time for coma to be induced.

(6) The varying nature of the conclusions reached by previous workers on the relative efficiency of intravenous and intramuscular insulin in producing coma has been probably due to the different standards of coma adopted by the authors.

(7) There is no *a priori* reason, following the above experimental work, why intravenous insulin should reduce the incidence of post-hypoglycaemic encephalopathies in Sakel's treatment of the deeper hypoglycaemic states, such as coma with areflexia, are induced.

(8) If, however, only the milder effects of hypoglycaemia are required, intravenous insulin is preferable to intramuscular as less insulin is required intravenously for these effects, and there is consequently a greater likelihood of the patient spontaneously awakening.

RESULTS OBTAINED DURING A TRIAL PERIOD WITH INTRAVENOUS INSULIN IN SAKEL'S TREATMENT.

Fifteen patients were given a full course (approximately 50 comas) of Sakel's treatment using intravenous insulin. The standard of coma adopted was that of unconsciousness with Babinski plantar responses and absent corneal reflexes.

The following general conclusions were drawn at the end of this trial period :

(1) Differences found in Sakel's treatment using (a) intravenous and (b) intramuscular insulin are :

(i) More insulin is required intravenously than intramuscularly.

(ii) The total period of hypoglycaemia each day is about 20-30 minutes shorter with intravenous insulin, but this is not of practical importance, since the blood sugar has to remain below 30 mgm. per cent. with both forms of administration for about 200 minutes before coma with areflexia can be produced. It is this long period of low blood-sugar values which

produces post-hypoglycaemic phenomena, and not the short period of mild hypoglycaemia which precedes it and which is shortened by the use of intravenous insulin.

(iii) There is a greater tendency to the spontaneous development of major epileptiform convulsions with intravenous insulin.

(2) Apart from the above differences, the effects appear to be the same for the two forms of administration. Coma is no quieter, after-shock as common and "arousal from coma" times no shorter with intravenous than with intramuscular insulin. Of the 15 patients, one developed a definite post-hypoglycaemic coma. This incidence of prolonged coma of 1 in 15 with intravenous insulin compares with 4 cases out of 146 treated by the author with intramuscular insulin. While the comparison cannot be exact with a small series of 15 cases, the figures indicate that intravenous insulin is at least as likely to be followed by prolonged coma as is intramuscular insulin.

Two of the points mentioned above will now be dealt with more fully :

(1) The case of post-hypoglycaemic coma following intravenous insulin.

(2) The greater tendency to spontaneous major epileptiform convulsions with intravenous insulin.

(1) CASE REPORT.—Patient 5 ; female ; aged 31.

Condition on admission (Banstead L.C.C. Hospital).—The patient is a paranoid schizophrenic whose illness is of 9 months' duration. She is able to give a fair account of herself, but shows marked blockage of thought. She believes that some other women have conspired against her because she has not had a baby, although she has been married for four years. These women have combined to form an organization which has installed an electrical machine in the hospital grounds. This machine generates songs which play upon her day and night. She is aurally hallucinated, and hears accusatory voices coming over the wireless and from underneath the bed at night. There is some incongruity between thought and mood, but she

Course of Insulin Hypoglycaemic Therapy.

Day of treatment.	Dose of insulin.	Duration of sopor.	Duration of coma.	Interruption by—
1	20	—	—	Drank glucose
2	40	—	—	" "
3	50	—	—	" "
4	60	—	—	" "
5	70	—	—	" "
6	80	—	—	" "
7	90	35 mins.	—	Nasal "
8	96	44 "	—	" "
9	100	53 "	—	" "
10	106	68 "	—	" "
11	112	75 "	—	" "
12	118	92 "	5 mins.	" "
13	118	104 "	—	" "
14	118	116 "	10 mins.	" "
15	118	112 "	20 "	" "
16	112	118 "	30 "	" "
17	104	126 "	30 "	" "
18	100	115 "	30 "	" "
19	100	98 "	25 "	" "
20	96	120 "	30 "	" "
21	96	132 "	30 "	" "
22	96	126 "	30 "	" and I.V. glucose.

is occasionally impulsive in behaviour. Her personality is fairly well preserved, but she has no insight into her mental state. The statement that she has not had a baby is itself a delusion, as she has three children alive.

Response to insulin.—As will be seen from the above record, there was nothing remarkable about the patient's response to insulin. She had been in coma nine times before the coma which became prolonged occurred on the 22nd day of treatment. On each occasion she had awakened normally on interruption with nasal glucose. During the afternoon of the day of the prolonged coma her temperature rose to 103° F., she showed marked myotonic spasms, but these were controlled by intravenous hexobarbitone. Vitamin B₁ was given subcutaneously without effect, and on the evening of the first day she was given a transfusion of one pint of blood. Although the bloods had been cross-matched, she developed an intense rigor shortly after the transfusion had been completed. She became extremely collapsed, the pulse could not be obtained, and she appeared to be dying. Coramine was given and she slowly revived. Fortunately her general condition was good when the transfusion was started, otherwise a fatal outcome would have been almost certain. The patient was a multipara, and it is probable that she was an Rh-negative subject who was transfused with Rh-positive blood. She remained unconscious for a total period of 46 hours after the initial interruption of coma and in the course of a few days recovered completely physically. There was no change in her mental state as a result of the prolonged coma, and later the course of insulin therapy was completed with moderately beneficial results.

(2) *The Greater Tendency to Spontaneous Major Epileptiform Convulsions with Intravenous Insulin.*

As has been mentioned previously, the term "convulsion" has been used in the literature on Sakel's treatment to cover both the intense myotonic spasms which are frequently seen in the deeper stages of hypoglycaemia and the typical major epileptiform seizures which closely resemble those seen in idiopathic epilepsy, and which are frequently marked by an initial cry, followed by a typical tonic stage which passes into an equally typical clonic stage, the whole convulsion lasting about 40–50 seconds. This section refers only to convulsions of the latter kind.

Incidence of convulsions.—Seven of the 15 patients who were given the full course of treatment with intravenous insulin developed major epileptiform convulsions. This is a very high proportion, and although the series is a small one, the proportion is probably significant when compared with the 14 patients who developed such convulsions in the author's series of 146 patients treated with intramuscular insulin. This would seem to be confirmed by the experience of 2 of the 7 patients who developed convulsions with intravenous insulin. Both of these patients would have a fit after each dose of insulin if the dose exceeded 440 units in the one case and 190 in the other. If, however, these doses of insulin were given intramuscularly no fits resulted. Ventriglia (1939), Reznikoff and Scott (1942) and Mahoney and Herskovitz (1942) also found a greater tendency to convulsions with intravenous insulin, although Polatin, Spotnitz and Wiesel (1940) found the same incidence and Sherman, Mergener and Low (1941) a reduced one. The greater frequency of convulsions with intravenous insulin can probably be ascribed to the more rapid, profound fall in the blood sugar causing a greater disturbance of the equilibrium of the motor cortex of predisposed patients than is the case with the more slowly acting intramuscular insulin.

Finiefs (1938) regarded spontaneous epileptiform convulsions occurring in

Sakel's treatment as beneficial, and likely to enhance the value of the treatment. The chief disadvantage of their spontaneous development is that the number of fits cannot be controlled or the time of onset. They may appear at any stage of hypoglycaemia, and while convulsions early in the period of hypoglycaemia may have no adverse effect, they are certainly undesirable in the deeper stages of hypoglycaemia, when the patient's general condition may be such that it ought not to be subjected to the extra strain imposed by a severe convulsion. If convulsions are deemed desirable in Sakel's treatment it is much better to induce them under controlled conditions by electrical means or by cardiazol. This opinion is confirmed by the experience of one of the patients given intravenous insulin. Following a spontaneous convulsion he complained of pain in the back, and on being X-rayed was found to have a compression fracture of the 5th dorsal vertebra. Had this fit been induced by chemical or electrical means the fracture might have been avoided, since, as Furst (1940) has pointed out, the placing of a small pillow under the mid-thoracic vertebra so as to extend the spine will reduce the incidence of vertebral fractures in convulsive therapy. The convulsions in the present series occurred usually between 90-110 minutes after the injection of the insulin, the time incidence being remarkably constant for any given patient. One patient had a number of convulsions on different days after a period of approximately 200 minutes of hypoglycaemia.

Opportunity was afforded by the frequent occurrence of major convulsions after the injection of intravenous insulin to study the behaviour of the blood sugar during and after the fit, and to compare the results with those obtained during and after fits induced by cardiazol (phrenazol) during hypoglycaemia. The blood sugar had been previously estimated every 30 minutes after the injection of the insulin, and the level of the blood sugar at the previous estimation was taken to be the level at the time of the onset of the fit. The blood sugar was estimated at intervals of 1, 2, 3, 4, 5, 6, 8, 10, 15, 20, 25, 30, 35 and 40 minutes after the onset of the fit, and a word of thanks is due to the members of the nursing staff, whose watchfulness enabled these times to be adhered to. The behaviour of the blood sugar during and after 12 spontaneous and 12 phrenazol-induced convulsions is set out in the following charts and table. The convulsions occurred in 8 patients.

TABLE XIV.—(1) *Blood-sugar Values During and After Spontaneous Insulin Convulsions.*

Number of convulsion.	Minutes after commencement of convulsion.															
	0.	1.	2.	3.	4.	6.	8.	10.	15.	20.	25.	30.	35.	40.		
1	24	24	27	38	43	45	47	46	41	37	32	28	25	25		
2	28	28	31	39	46	50	50	48	42	37	31	27	26	26		
3	27	28	32	41	52	50	50	49	44	40	33	28	29	28		
4	24	25	29	37	37	46	47	45	41	35	30	26	25	24		
5	24	24	27	37	43	43	48	44	38	34	34	28	27	28		
6	25	24	26	35	42	45	47	42	38	33	27	24	24	22		
7	29	29	32	40	41	45	48	47	42	38	33	28	28	28		
8	31	32	34	44	47	51	53	51	45	39	33	33	32	33		
9	26	26	29	37	43	48	49	48	44	40	40	32	28	28		
10	27	29	32	38	44	49	52	51	46	41	36	28	27	27		
11	26	25	27	34	44	46	49	45	40	36	30	25	24	20		
12	28	28	31	41	46	49	51	47	41	36	37	29	30	30		

(2) *Blood-sugar Values During and After Phrenazol-induced Convulsions During Hypoglycaemia.*

Number of convulsion.	Minutes after commencement of convulsion.															
	0.	1.	2.	3.	4.	6.	8.	10.	15.	20.	25.	30.	35.	40.		
1	24	25	32	39	55	66	75	74	68	60	55	46	37	37		
2	24	24	31	37	48	56	56	52	44	37	30	25	26	25		
3	27	26	33	38	46	54	62	63	58	47	35	29	26	26		
4	26	26	31	41	54	69	73	69	62	56	50	41	33	29		
5	20	22	32	40	32	68	68	63	60	51	45	38	29	24		
6	23	23	30	39	53	64	60	55	51	43	34	28	35	25		
7	23	22	28	37	44	52	59	59	51	45	45	34	28	28		
8	25	25	31	42	59	71	69	65	61	56	53	42	33	27		
9	26	28	32	45	69	69	65	53	54	45	33	27	27	26		
10	31	28	37	46	55	63	61	54	46	37	33	29	30	30		
11	29	29	33	41	52	61	72	69	63	57	50	42	33	30		
12	22	24	29	41	58	58	54	49	45	37	34	31	29	27		

From the foregoing charts and table it will be seen that—

(1) *In Spontaneous Hypoglycaemic Convulsions—*

(a) All 12 convulsions occur when the blood sugar is between 20–30 mgm. per cent.

(b) The blood sugar starts to rise immediately the convulsion is over and reaches the highest point in 6–10 minutes, after which it begins to decline until it reaches the pre-convulsive level in about 40 minutes.

(2) *In Phrenazol-induced Convulsions During Hypoglycaemia—*

The post-convulsive increase in the blood sugar is not nearly as constant as it is after the spontaneous convulsions, varying as it does from 30–50 mgm. per cent. This is probably due to the fact that the patients were unlikely to be given the exact convulsive dose of phrenazol, and any additional phrenazol over the necessary minimum would result in a more severe convulsion with a greater increase in the blood sugar.

As an explanation of the post-convulsive behaviour of the blood sugar it is suggested that the convulsion results in the depletion of glycogen in the muscles, which is replaced by the formation of glucose from glycogen in the liver under the influence of adrenaline. The newly formed glucose raises the blood level as it travels from the liver to the muscles for reconversion into muscle glycogen.

CONCLUSION.

The following conclusions emerge from the experimental work described and from a study of the literature reviewed :

(1) *The Value of Intravenous Insulin in Reducing the Incidence of Post-hypoglycaemic Encephalopathies in Sakel's Hypoglycaemic Treatment.*

This depends entirely upon the depth of hypoglycaemic coma which it is desired to produce during the treatment.

(a) If the production only of unconsciousness is desired, intravenous insulin is of value as a smaller dose is required than that of intramuscular insulin, and the more rapid return of the blood sugar to normal with the doses of insulin

required to induce this state diminishes the possibility of the patient remaining sufficiently long in coma for post-hypoglycaemic encephalopathies to develop.

(b) If the considerably deeper state of unconsciousness with positive Babinski reflexes and absent corneal reflexes is desired, intravenous insulin has no advantage over intramuscular or subcutaneous insulin since a larger dose is required. The use of these larger doses, necessary to maintain the blood sugar at a sufficiently low level for the required period of time, prevents the blood sugar from spontaneously returning to normal until sufficient time has elapsed for post-hypoglycaemic encephalopathies to develop.

(2) *Disadvantages of Intravenous Insulin in Sakel's Treatment.*

(a) Greater frequency of uncontrolled spontaneous major epileptiform convulsions.

(b) The possibility of anaphylactoid shock occurring in patients sensitive to insulin.

(c) More insulin is required to induce the deeper hypoglycaemic states.

(3) *Advantages of Intravenous Insulin in Sakel's Treatment.*

(a) The time occupied by the treatment is reduced by about 30 minutes each day.

(b) The milder hypoglycaemic states can be induced with less insulin with a greater possibility of spontaneous awakening of the patient.

Reviewing the subject as a whole, it may therefore be said that intravenous insulin offers insufficient advantages over intramuscular insulin in Sakel's treatment to justify its use.

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THE PSYCHO-SOMATIC SEXUAL LIFE OF THE FAMILY : A PSYCHO-SOMATIC STUDY OF SUCKLING AND COITUS.

C. E. H. TURNER, M.R.C.S., L.R.C.P., D.P.M.,
Deputy Medical Superintendent, The Towers Hospital, Leicester.

THIS is a field of knowledge which has been neglected unduly and which, should prove fruitful in view of the recognized importance of sex in psychology.

Pearse and Crocker (1944*a*), in their study of the family, that unit with which is associated suckling and coitus, leave out psychology, saying there is no normal psychology described.

Ellis (1928*a*) described fully the anomalous association of love and pain, but he does not attempt to analyse it further than speaking of the "joy of emotional expansion" aroused by love and pain. He wishes to avoid "a somewhat speculative and metaphysical region"; yet a theory to account for the many known facts of sex is needed.

Flugel (1921), writing on the family, admits that he has little to say on the relationship of the husband and wife; yet that relationship is the foundation of the family.

"Pleasure and 'pain' cannot," says Freud (1924*a*), "be referred to a quantitative increase or decrease of something which we call stimulus-tension, although they clearly have a great deal to do with this factor. It seems as though they do not depend upon this quantitative factor, but upon some peculiarity in it which we can only describe as qualitative. We should be much farther on with psychology if we knew what this qualitative peculiarity was."

Van De Velde (1931*a*), speaking of sexual hostility in marriage, says: "If we refer to books by experts on the subject, we find a great number of analytical descriptions of cases where a hatred between the sexes appears to be the primary focus of the phenomenon, but we look in vain for a definite, fundamental and comprehensive attitude towards the problem."

It is the object of this paper to make a contribution to a "definite fundamental and comprehensive attitude" which shall depend on a "qualitative" factor.

It is proposed to put forward a theory for the psycho-somatic understanding of suckling and coitus. Social and religious aspects of sex will only be referred to in this paper where it is necessary to illuminate the theory of suckling and coitus, which are not essentially social or religious but family functions. Some clinical implications of the theory will be referred to in general terms, but a detailed exposition of the theory applied to clinical material is left for another

paper, and the initial statement of the theory together with the evidence and comments will be given now.

I propose to deal with the subject as follows :

- A. Psycho-somatic facts of suckling and review of previous explanations.
- B. Psycho-somatic facts of coitus and review of previous explanations.
- C. A psycho-somatic theory.
- D. Comment on the theory.
- E. Conclusion.
- F. Bibliography.

A. PSYCHO-SOMATIC FACTS OF SUCKLING AND REVIEW OF PREVIOUS EXPLANATIONS.

The psycho-somatic facts of suckling are the mother-baby love relationship implicit in the physical act of lactation.

(a) *Animal Identification.*

The understanding of suckling is, however, linked with the idea of the mother being identified with an animal. Psycho-analysts describe as occurring in the "oral stage" of the child an idea of "being devoured by some fierce monster." There are many examples in the literature; thus Klein (1929) reports the case of a boy, aged $4\frac{1}{2}$, who made her, during the psychoanalysing, play the part of a "fairy-mamma" who "used to heal with a magic wand all the wounds which the boy's harsh parents had inflicted on him; then he and she together killed these harsh parents in some cruel way." He would also imagine he was attacking a mother-lioness or that he was the lioness, or he made the analyst enact the lioness and then change back into a helpful "fairy-mamma."

The myths and folk-lore which children love abound in such stories as Red Riding Hood in danger of being devoured by a wolf in the guise of her grandmother. Freud (1940), following Rank, describes an "abridged myth" of peoples for their national heroes, in which the hero as a child is cared for and even suckled by an animal.

The idea is extremely old, for totemism is based on the idea of the tribe being descended from the totem animal.

(b) *Ambivalence.*

There is apparently a contradiction in the love between parents and their young. In the totem ceremonies is found the killing and eating of the parent, who is also mortally feared.

It has also been reported that fear and anger are keenly felt by the baby at the mother's breast. The baby is described as experiencing acute anxiety at the earliest oral or "cannibalistic" stage (Abraham, 1927; Middlemore, 1941a). Melanie Klein (1932a) reflects that "The idea of an infant from 6 to 12 months trying to destroy its mother by every method at the disposal of its sadistic tendencies . . . presents a horrifying, not to say an unbelievable, picture to our minds. And it is difficult, as I know from my own experience, to bring oneself to recognize that such an abhorrent idea answers to the truth,

but the abundant force and multiplicity of the imaginary cruelties which accompany these cravings are displayed before our eyes in early analyses so clearly and forcibly that they leave no room for doubt." This does not apply to abnormal children only. "Analytic experience of healthy children of various ages has convinced me that even though their ego reacts in a normal way they too have to face great quantities of anxiety, severe unconscious guilt and deep depression, and that in some cases the only thing that distinguishes their difficulties from those of the neurotic child is that they are able to deal with them in a more confident and active manner (Klein, 1932*b*).

This anxiety in the baby appears to be matched by aggressiveness in the mother. Lashley (1915), in describing the reaction of a colony of terns to the introduction of a strange chick, says, "The sight of the strange chick calls out movements of attack" by one or more adult birds, but "when the attacked chick forces its way under the body of the aggressive adult, thus inhibiting the aggression and stimulating a brooding response," it is apparent that the aggression has been converted into a brooding response.

Middlemore (1941*b*) draws attention to the belief of the medical school of Douai that "mother's milk was supposed actually to poison children and breast feeding was forbidden." She also describes (1941*c*) the fear of some normal mothers "that their babies would die at the breast" should they there fall asleep.

"As well as her love for her child then," says Groddeck (1935*a*), "there exists in every mother an aversion for the child. Man lives under the law: Where love is, there is also hate; . . . The authority of this law is inviolable, and even mothers are no exceptions."

McDougall (1940*a*) describes the parental instinct in terms of the "tender emotion," yet Freud (1925*a*) states tenderness masks aggression and fear.

Middlemore (1941*d*) refers to the eighteenth-century tendency of doctors to believe "that the mother's strength drained away during nursing." She listened (1941*e*) to the spontaneous remarks of normal mothers suckling their children. "One mother complained of 'gnawing pain,' although her baby did not gnaw the nipple at all. Another felt her strength 'drain away' as the child sucked; the inference was that he drained it. A third used a curious expression: 'He seems to wring me'." As a result of watching suckling Middlemore (1941*f*) states, "I had the impression that active babies with a habit of biting would not have succeeded so well unless their mothers had actually enjoyed it." Another mother "made comical gestures of withdrawal and drew in her breath with a hiss of pretended fear when she was nipped." It was noticed that if the mother could not enjoy or tolerate being bitten by the baby, suckling was impeded or ceased. One mother who tried to feed her first baby, "a wild, restless suckling," gave no sign of fear, but developed exophthalmos: "she lost her milk quite suddenly on the evening of the fourth day, and by next morning there was no sign of exophthalmos either." She remarked later by chance that she had feared her obligation to feed the baby.

When mental illness opens the floodgates of the unconscious mind a lactating woman will often describe a belief that her milk has been poisoning her.

baby, or she will make, or feel urged to make, violent and murderous assaults on her baby. The consequent early weaning of the baby often uncovers suicidal wishes in such a lactating woman.

Previous Explanations.

(a) *Animal Identification.*

Riviere (1936a) says these animal ideas derive from stories of wild beasts or experiences with animals, and adds "the other and, of course, even more significant source of such phantasies of animals and monsters within is the 'totemic' mechanism, the effort to substitute for the parents, as objects of all the aggressive and sadistic impulses, animals whom one may and possibly can legitimately kill (and eat) without the most terrible consequences."

"It is the father," says Freud (1924b), "who is regarded as the totem animal and is thus feared by the baby in 'the primitive oral stage of libido-organization'." Flugel (1945a) repeats the belief, saying, "At the most primitive or oral stage, masochism will show itself in the fear of being devoured by some fierce beast, ogre, or monster—ultimately a father figure." Similarly Klein (1932c), referring to infantile animal phobias, speaks of "displacement on to an animal of the fear felt of the real father."

These explanations of ideas of identification of human parents with animals are somewhat inadequate. Groddeck's self-analysis always brought in the wolf in his repressions, but he had to say to himself (1935b), "It is always coming up anew, however much you analyse yourself, and never do you find the answer."

(b) *Ambivalence.*

Freud often regards aggression in the baby as a primary instinct.

Suttie (1935) says, "I am suggesting that in animals born or hatched in a state of nurtural dependency the whole instinct of self-preservation, including the potential dispositions to react with anger and fear, is at first directed towards the mother." He regards the baby's aggression towards the mother as "the maximal effort to attract attention" aroused by separation from the mother. He lays emphasis on the purpose of attracting the mother. Middlemore (1941g) says that the baby's phantasies of fear and aggression towards the breast "express something of the child's tension of hunger and his struggle for food."

Dollard, Miller, Doob, Mowrer and Sears (1939), writing on frustration and aggression, state that "aggression is always a consequence of frustration." This is the view taken often by the psychoanalytic school. Klein (1932d) speaks of sadism of the baby "against its mother's frustrating breast." The origin of anxiety in the baby is said by Freud (1936a) to be due to the danger it feels when the mother does not gratify its needs.

The baby's fear is said to be anxiety, due to its "cannibalism," or it is said to feel threatened by its own aggressiveness towards the breast; thus Riviere (1936b) says, "I suggest that such helplessness against destructive forces within constitutes the greatest psychical danger-situation known to the

human organism ; and that this helplessness is the deepest source of anxiety in human beings."

Aggression of the baby is frequently described as being the cause of its own fear. Klein (1932*e*) admits this, but also describes aggression as arising from fear : " It would appear that he (the child) displaces the full burden of his intolerable fear of instinctual dangers on to his object, thus exchanging internal dangers for external ones. From these external dangers his immature ego then seems to protect itself by destroying his object." No doubt anger may turn to fear and fear to anger, but the mechanism throws no light on the origin of both. In view of these limited explanations it is no wonder that Freud (1933*a*), discussing anxiety and the instinctual life, says, " The question of the stuff out of which anxiety is made loses interest for us."

The child is also considered to project its own aggressiveness on to the mother in phantasy that she will in her turn destroy the child ; there is a " fear of retaliation " for sadistic phantasies (Klein, 1932*f*). Similarly, the mother's fears are attributed to projection (Middlemore, 1941*h*) : " Unconsciously she expects him (the baby) to attack her breast as strongly as ever, in fantasy, she attacked her mother's breast."

The real difficulty is not, as is said often, that the psychoanalytic theories have been based on neurotic patients, but that the theories take unfortunate situations for their basis. Thus aggression of the baby in suckling is ascribed to separation from the mother, or to frustration. Fear is ascribed to projection in phantasy of the child's " wrongful " aggression on to the mother : fear of castration by the father is punishment for an incest wish.

The psychoanalysts regard the relationship between the mother and the baby as being free from fear and aggression until the baby or the mother or the father does wrong or is imagined by the baby to do wrong. It is to this wrong, duly repressed, that fear and aggression are ascribed.

Jones (1938*a*) says " children come to the world with potential trends and desires which are innocent enough at an early age, but which are of such a kind that the gratification of them is highly unacceptable to adult standards." He goes on to say that the thoughts and wishes for primitive egotistic enjoyment and concern with certain bodily functions are repressed and become " invested with painful and guilty feeling." Ambivalence is, therefore, regarded as acquired and not essentially biological. Since so much of psychoanalytic theory is concerned with ambivalence, it is understandable that some should say that it is not a normal psychology but psycho-pathology of the family which is described.

B. PSYCHO-SOMATIC FACTS OF COITUS AND REVIEW OF PREVIOUS EXPLANATIONS.

(a) *Animal Identification.*

The belief in human transformation into animals which is associated with suckling is also found in connection with coitus. The idea of transformation into animals to effect coitus is well known in mythology. Coitus was practised also in association with totem-animal ceremonies ; and in primitive magic,

rites of sexual significance are associated with representations of animals (Roheim, 1930a; 1934).

Neurosis and psychosis provide numerous examples of ideas of animals in association with erotic emotions.

(b) *Ambivalence.*

Love is also found and described associated with anger and fear in coitus as it is in suckling. Husbands and wives quarrel all too easily, sometimes apparently with some satisfaction; at other times love too frequently turns to hate between the partners. "This is the matter to be determined," says Van De Velde (1931b): "Does there exist in addition to hatred, as opposed to love, or to sexual repulsion as opposed to sexual attraction . . . a primary genuine sexual hostility? However much I may deplore the fatalistic inferences which, apparently, to some extent at least, must be deduced from this, I find myself compelled to answer the question in the affirmative."

The theme of love with anger and fear will be traced from animals to primitive people, children, adolescents and adults.

Animals.—Ellis (1928b), says "Among very varied species wounding and rending normally take place at or immediately after coitus; if we go back to the beginning of animal life in the protozoa sexual conjugation itself is sometimes found to present the similitude, if not the actuality, of the complete devouring of one organism by another." He observes that "Every animal in some degree owes its survival to the emotional reaction of anger against weaker rivals, to the emotional reaction of fear against stronger rivals. To this cause we owe it that these two emotions are so powerfully and deeply rooted in the whole zoological series to which we belong. But anger and fear are not less fundamental in the sexual life." Ellis (1928c) also refers to Darwin—"Darwin himself said that nothing is commoner than for animals to take pleasure in practising whatever instinct they follow at other times for some real good. These manifestations are primarily for the sake of producing sexual tumescence . . ."

Tillier (1889) pointed out that there is a normal coexistence of combat and courtship.

Hamilton (1914) says "at least two, and possibly three, different kinds of hunger, or needs of individual satisfaction, normally impel the macaque towards the manifestation of sexual behaviour, viz., hunger for sexual satisfaction, hunger for escape from danger and, possibly, hunger for access to an enemy."

Zuckerman says that Bingham (1928) has shown that the sexual presentations of chimpanzees at times when they were fed had "unmistakable roots" in previously exhibited behaviour connected with fear and rage.

Zuckerman (1932a) described "the transition of the aggressive attitude of a monkey to one of sexual interest when it is presented with a sexual stimulus by the animal whose activities have aroused its aggression." Describing the communal life of the baboon, which is based upon a system of dominance, he says: "Sometimes an overlord may suddenly draw the aggression of his neighbours for no obvious reason . . . at such times, and at others when the

overlord has evoked the combative activities of his fellows, his female or females usually and immediately assume a copulatory position and crowd round him—in a monogamous party, the male mounting his female as he threatens his attackers."

Ellis (1928*d*) remarks that "In animals the connection between love and anger is so close that even normally, as Gross points out, in some birds the sight of an enemy may call out the gestures of courtship."

Primitive people.—Crawley (1902), referring to primitive marriage by capture, speaks of "a ceremonial use of force, which is half real and half make-believe."

Roheim (1930*b*) refers directly to the attitude of primitive people to coitus: "The equivalence of coitus and death is certainly the unconscious concept that is at the bottom of animism and magic. . . . Going to war seems to be regarded as another form of coitus, or coitus as another shape of death or murder."

Children.—Children evidently have similar ideas. Klein (1932*g*) says, "The death wishes he (the child) feels against them (the parents) during the primal scene or in his primal phantasies are associated with sadistic phantasies which are extraordinarily rich in content and which involve the sadistic destruction of his parents both singly and together. The child also has phantasies in which his parents destroy each other by means of their genitals. . . . These phantasies have important effects and are very numerous, containing such ideas as that the penis, incorporated in the mother, turns into a dangerous animal . . . or that her vagina, too, becomes a dangerous animal, or some instrument of death . . ." Speaking of the sexual development of the girl, Klein (1932*h*) says, "Her fear of the sexual act is thus based both on the injuries she expects to receive from the penis, and on the injuries she will herself inflict on her partner."

Adolescents.—Marro (1898) is referred to by Havelock Ellis on this subject: "With the epoch of the first sexual relationship, Marro points out, awakes the instinct of cruelty, which prompts the youth to acts which are sometimes in absolute contrast to his previous conduct, and leads him to be careless of the lives of others as well as of his own life."

Adults.—The instinct having awoken, matures. Nietzsche (1911) does not soften the blow: "Have people had ears to hear my definition of love? It is the only definition worthy of a philosopher. Love, in its means, is war; in its foundations, it is the mortal hatred of the sexes." Weininger (1906*a*) makes the aphorism, "Love is murder."

Freud (1933*b*) supposes that "there are two fundamentally different kinds of instincts, the sexual instincts . . . and the aggressive instincts"; although "the instincts of aggression are never alone, they are always alloyed with the erotic ones." Freud (1924*c*) also says that the association in general between the sexual instinct and the emotions of fear and dread is a very intimate one.

Jones (1931*a*) stresses the sexual significance of the nightmare and describes amongst the "cardinal features of the malady" a helplessness and an "agonizing dread." It is the experience of the present writer that these same features

are also found with evidence of sexual significance in the terrifying hallucinations found in melancholia and other mental illness.

The evidence, then, is very strong that there is an association of sex with aggression and fear.

Apparently both anger and fear are the roles played by each sex; thus the well recognized sexual perversions of sadism and masochism are found in both sexes (Krafft-Ebing, 1934; Hirschfeld), and Flugel (1945*b*) says that "to regard masochism in general and any type of masochism in particular as specifically feminine is no more justified than is the long-since discarded theory that hysteria is a specifically feminine disease."

In courtship it is normally the male who is aggressive; as Howard (1940) says of the water hen species, "pecking and chasing belongs to the cock." The sexually aggressive male is well recognized.

On the other hand, it would appear that at the orgasm the roles played by the male and female reverse, so that the female is then aggressive and the male is subjected. Ellis (1928*e*) says "the tendency to bite at the climax of sexual excitement is so common and widespread that it must be regarded, when occurring in women, as coming within the normal range of variation in such manifestations."

Wiley, Vander and Fisher quote the dictum of the Roman physician Calenus that "every animal is depressed after coitus, except the woman and the cock," and these authors confirm that "men are very frequently morose after the sexual act."

Associated in the unconscious mind with ideas of sex are found ideas of castration. "The fundamental dread of primitive man," says Roheim (1930*c*), "seems to be the dread of castration, or, what amounts to the same thing, from the unconscious point of view, the dreaded expenditure of semen."

Similarly in some species of the insect world the male dies literally at the end of the act of coitus, the case of the bee being well known. Maeterlinck (1902) describes this "hostile madness of love. Most creatures have a vague belief that a very precarious hazard, a kind of transparent membrane, divides death from love, and that the profound idea of Nature demands that the giver of life should die at the moment of giving. Here this idea, whose memory lingers still over the kisses of man, is realized in its primal simplicity. No sooner has the union been accomplished than the male's abdomen opens, the organ detaches itself, dragging with it the mass of the entrails, the wings relax, and, as though struck by lightning, the emptied body turns and turns on itself and sinks into the abyss."

Previous Explanations.

(a) Animal Identification.

Jones (1931*b*) speaks of "the idea that a human spirit can pass into the body of another person or of an animal and that the reverse process can also happen. This was and is one of the most widely-spread superstitions of the world." He attributes the belief to dreams, and especially to nightmares in which people turn into animals. He says (Jones, 1931*c*), "the malady known as nightmare is always an expression of intense mental conflict centreing about

some form of 'repressed' sexual desire." The nightmare may include in women ideas of sexual assault and in men seminal emissions. Jones has also traced the same factors of sex and animal transformation in the medieval erotic beliefs in witches, vampires, werewolves and the devil.

The fact of the connection between sex and ideas of animal transformation is clear, but it is not an adequate explanation to say that this is so because sex is expressed in dreams with animal transformation, unless one can give the reason for animals being pictured in sexual dreams. Jones (1938*b*) says that "if a person's conduct or appearance resembles in some way that of a lion or bull, he may masquerade in a dream in the form of the animal."

Jones (1938*c*), in writing of the genesis of symbolism, gives three factors which "are operative in this general primitive tendency to identification": the first is that "the primitive mind very often does not discriminate" one object from another due to "mental incapacity"; the second is that "when the primitive mind is presented with a new experience it seizes on the resemblances, however slight, between it and previous experiences"; and the third factor is that "the appreciation of resemblances facilitates the assimilation of new experiences." He elaborates these factors to "throw some light on one of the most puzzling phenomena of symbolism—namely, the extraordinary predominance of sexual symbols."

(b) *Ambivalence.*

Huxley (1930) finds it to be a general rule that the method of courtship in different species of birds is related to the respective roles taken by male and female "in the reproductive duties of building the nest, sitting on the eggs, and feeding and guarding the young."

Marro (1901) says that the frequent presence of force in the courtship of savages is to allow the female to test the man's virility, for in the struggle for life violence is the first virtue.

Zuckerman (1932*b*), describing the transition in a monkey from an aggressive attitude to sexual interest when presented with a sexual stimulus, says "it is possible that these liberated sexual responses are socially conditioned from flight reactions stimulated by fear. . . . The monkey's presentation in social situations of this nature is then all that is left of its original reaction of flight from the environment of fear and discomfort."

Ellis (1928*f*) says that in the playing of the hunter and the hunted in courtship "is attained in both male and female that charging of nervous energy, that degree of vascular tumescence, necessary for adequate discharge and detumescence in an explosion by which sperm-cells and germ-cells are brought together for the propagation of the race."

Psychoanalysis has usually explained anxiety in the adult, which is associated unconsciously with sex as being due to regression, to primordial life, or to birth, or to childhood.

Ferenczi seeks the explanation in the beginnings of all living matter. Thus the anxiety of sex is believed by him to be the survival of the archaic multiplication by fission; the propagation of the species is regarded as the death

of the individual. Otto Rank attributes the anxiety of the anxiety neuroses to the anxiety-experience of birth.

Freud's (1933c) explanation is by regression to childhood, and he attributes sexual anxiety in the male to fear of castration by the father for an incest wish and in the female to fear of loss of love.

Jones (1938d) and the psychoanalysts in general also speak of a regression to a level at which erotic and aggressive and fearing elements are more intimately related or fused.

There is, however, a psychoanalytic theory which relates sexual anxiety to current events. Freud (1924d) believes that anxiety neurosis is due, for example, to coitus interruptus, for he regards "a series of injurious conditions (noxae) and influences within the sexual life as important factors in aetiology." Thus the psyche "develops the neurosis of anxiety when it feels itself unequal to the task of mastering (sexual) excitation arising endogenously." He does sometimes, therefore, relate adult anxiety to adult coitus, but only to an unsatisfactory sexual life.

Roheim (1930d), on the other hand, relates these sexual emotions to the future, and regards them apparently as a sop for worse to come. He says, "Compared to death itself, the idea of death as a coitus, even of castration, is merely a substitute, a consolation offered by the unconscious."

The present writer suggests that the explanations which have been given hitherto for the facts of coitus are unsatisfactory and are incomplete.

He sets out therefore his thesis on the two components of sexuality under consideration; the one is the first activity of the newborn with its mother, and the other is the instinctive portal to the beginning of a new generation.

C. A PSYCHO-SOMATIC THEORY.

Suckling.—The act is a primitive one and its emotions, too, are assumed to be primitive. The primitive animal has to learn to kill and to escape death, for without this teaching it would surely die in its wild environment.

The instincts of pugnacity and of flight are present at birth, but in the immature mammalian young who need suckling these instincts are reinforced and developed by the parents. At the romping stage the primitive mother is well known to give the young practice in these instincts, and it is unlikely that in the stage of lactation, between instinctual heritage and romping, there is no corresponding emotional rapport between the mother and its young.

The mother is to its young an environment which, it is assumed, must reflect at all stages the environment which the young will later experience when adult.

It is postulated, therefore, that by the emotions of suckling the mother plays the part of the inferior species of animal which must in due course be hunted for food by the baby, and she also plays the part of the superior species of animal which must be mortally feared by the baby.

The mother therefore "kills" the baby by whom she is "killed."

The emotions of the lactating mother and the baby are symbolic of the life of the jungle, to which the primitive young must eventually go. The mother

in loving lactation arouses in the baby the emotions of its livelihood, for which it must kill and avoid death.

Coitus.—The description of the psycho-somatic manifestations of coitus is based on the theory that in the physical procedure is implicit a demonstration by the female that she can and will provide the emotional background already described as necessary for rearing the primitive young, and a demonstration by the male that he can and is willing to risk death in pursuit of food for them.

It is, in general, essential that the primitive male and female co-operate in this way if procreation is to be brought to a successful conclusion in a new adult generation.

It is convenient to describe three stages of coitus—that of courtship, of the act up to orgasm, and of orgasm itself.

Courtship consists of the female taking the part of the member of an inferior species which is innocent of impending danger, becomes alarmed as it senses the approach of the attacker, objects to being killed, attempts to escape in fear, but is caught by the killer.

In the second stage, that of the act up to orgasm, the “victim” is “killed” by the male. The male thus pledges his ability to kill prey as food for the family. The female is partly reassured by this pledge. She, by acting the death of the victim, pledges her ability to do the same for their baby, that it may learn. But the parties are not yet satisfied.

In nature the male on going out to kill his prey risks death from a member of a superior species. In the orgasm the female acts the superior species which kills the male, eviscerates and eats him. The evisceration of the male is portrayed by his emission, and she tests his willingness to do his duty even unto death, if that be the need. He meanwhile is reassured that she, by acting the superior species, will make a mother who is capable of educating their young in the dangers ahead of them.

Thus coitus is a symbol of what shall be. It is postulated that not only are the young conceived through coitus, but that also in the mating couple is conceived that relationship of duties as the result of which the young will thrive.

The couple in coitus witness the one to the other by their act, and in the act test each other in their respective parental duties.

D. COMMENT ON THE THEORY.

General.—It is clear that the theory gives a standard by which the significance in life of suckling and coitus may be assessed.

The theory is intended to explain the norm of reproduction where there has been differentiation of the sexes. No attempt is made here to follow up the variations on the norm which are consequent on environment affecting the evolution of reproduction in various species.

It is not supposed here that animals, or even necessarily human beings, have conscious knowledge of the meaning of suckling or coitus as described in the theory of this paper. The operation of an instinct is being described and an instinct once aroused tends to progress towards its fulfilment, apart from

conscious recognition of its mechanism or meaning. It would be more correct to say that in general only species whose sex life has in some form enshrined these principles have survived.

The theory is founded on the unfailing providence for the next generation which, even in animals, rises to something akin to a devoted, selfless love. The primitive purpose of sex is the survival of the species, and for this, which will continue "for ever" when they are dead, mated animals live. Lovers whisper over their kisses that it shall be "for ever"; and religion, in its own sphere, stressing the importance of such immortal thoughts, declares the relative unimportance of the passing physical life except as part of eternity.

It is true that coitus is not now confined to times of female rut, is often not practised, or when practised, is often not necessarily intended for procreation; physical contraception is added to the mental hope of at least episodic sterility and the act then loses its primitive purpose. No one, however, who is endowed with the primitive apparatus of sex, used naked or sublimated, can, without frustration of the instinct itself, ignore combining also with others in a purpose which lives after them.

Suckling has been over-sentimentalized, and coitus has been regarded disproportionately as an expression of "the pleasure principle," and a means of "gratification"; the psycho-somatic theory of this paper conforms on the other hand to Huxley's general rule for birds that the method of courtship is related to reproductive duties. According to the psycho-somatic theory of sex, suckling performs the duty of emotional education of the young, and by coitus the respective duties of each parent are pledged. This physical symbolization of moral values is not confined to coitus. Clausewitz says of war that "fighting is a trial of strength of the moral and physical forces by means of the latter" (Greene, 1945). The same relationship of a physical act enshrining moral values is recognized and applauded in games; and is revered in religious practices. Freud grasped this principle in the psycho-pathology of conversion hysteria, and psycho-somatic medicine has the same foundation. It will be made evident that, according to the psycho-somatic theory of this paper, many moral values which are generally accepted in society are found in the primitive family, and that they are expressed implicitly in suckling and coitus.

The principles described in the theory of this paper are an elaboration of the dictum of Pearse and Crocker (1944*b*) that the family is the "instrument for the cultivation of functional efficiency." As Alverdes (1927) says, "even though a chicken will develop into an ordinary fowl without imitating the mother bird, its instinctive activities come into play earlier and with greater certainty when it has the opportunity of doing so . . . young beasts of prey reared in isolation would doubtless develop predatory methods similar to those of animals which had enjoyed the advantage of parental instruction; but theirs would probably be found to lack polish."

It is the theory of this paper that in suckling the instincts of the baby are given their first parental cultivation, and that the instincts of the parents to care for the young are pledged in coitus.

This is in accordance with the best traditions we know, but these primitive

acts of suckling and coitus use means which, compared with civilized customs, contain an anomaly and a paradox. The anomaly is the identification of women with animals; and the paradox is the ambivalent expression of love by the rehearsal of killing and death in acts of suckling and coitus.

Before *Homo sapiens* evolved away from the insecure jungle he required the jungle characteristics of sex, but although he has changed and developed in many ways, his sex apparatus remains relatively unchanged. Thus it is the purpose of this paper to show that, though reckoning himself above the beasts, mankind still shares the sexual emotions of the jungle (ambivalence), and the female of the human species plays the part of timid and savage animals of other species (animal identification).

The intrinsic presence of animal identification and ambivalence within normal suckling and the normal sexual act explains therefore the presence in civilized people of the archetypes of Jung.

Psycho-therapy, therefore, has to deal with normal primitive psychology which has been given psycho-pathological expression instead of expression in acceptable forms. This view of a normal primitive psychology in sex follows from the psycho-somatic theory of sex of this paper. Psychoanalysis, on the other hand, has accepted the material of the unconscious mind as predominantly pathological. Thus Jones (1938e) says, "The mode of action of the treatment, in a word, is that the overcoming, by means of psychoanalysis, of the resistances that are interposed against the making conscious of the repressed unconscious material gives the patient a much greater control over this pathogenic material . . ."

Some of the mechanisms of the unconscious mind described by the psychoanalysts and others exist also within the normal sexual acts of suckling and coitus.

Animal identification and ambivalence will be considered, therefore, from the point of view of normal psychology and of psycho-pathology.

Animal Identification.

(a) Normal Psychology of Animal Identification.

That which has been called animal identification is necessary primitively. This is because the female, in order to train the young in the nature of its future environment and to be able to assure the male in coitus of her ability to do so, has not, in suckling and coitus, the use of elaborate language. When she wishes to portray the environment she must act it. She thus introduces the first elaboration of perhaps the earliest of all sign-languages. The baby in suckling and the male in coitus use the simplest sign language—they just express their feelings. But the female takes the next step in this primitive language. She expresses not herself but the environment for which the baby is being educated, and in which the male must work when he puts into practice the hunting he is expressing to her. (It follows that in herbivora she must convey to her young what it will be like to eat vegetable matter, but for the ease of explaining this theory the case of carnivora which hunt smaller animals is considered.)

She therefore acts the part of the inferior hunted species and of the superior feared species. We have here a primitive basis for the familiar mechanism of identification.

This mechanism of animal identification involves dissociation and depersonalization. The woman is self-effacing, and dissociates her own personality from what she expresses sexually. Dissociation, in spite of the well known pathological forms of it, is therefore an aspect of normal primitive sexuality. The normal primitive personality is expressed by hunting and avoiding death, but woman does not thus express sexually her personality; sexual depersonalization, therefore, takes place, and she expresses the characteristics of the animals with which her family come in contact.

Animal identification in sex also gives a fundamental and biological explanation for the ideas of human transformation into animals for suckling and coitus found in mythology and folklore, and also explains why rites of sexual significance should be practised in the primitive ritual of the totem animal.

It is perhaps significant that at the time humanity was first placing a taboo on incest, it should also have established a ritual of sexual significance with an emblem which denoted parenthood, for primitive man believed he was descended from the totem animal. Man thus made his first primitive sublimation to help him keep his first repression.

The totem animal appears in some myths to have been regarded as originating from woman, for Frazer (1910a) speaks of "myths in which a human ancestress is said to have given birth to an animal of the totem species." It is now suggested that this myth is derived from the sexual identification of woman with animals of other species.

Primitive man also considers himself as being one with his totem, just as a member of a family identifies himself with the family. Thus "the relation between a man and his totem is one of mutual help and protection" (Frazer, 1910b).

It is also known that "the totem gives his clansmen important information by means of omens" (Frazer, 1910c), as similarly it has been described in the psycho-somatic theory that suckling gives the infant "important information" in teaching it the rudiments of anger and fear.

Frazer (1910d) says, moreover, that "one at least of the functions of a totem clan is to provide a plentiful supply of its own totem animal or plant to be used as food by the other members of the tribe," which is precisely what the psycho-somatic theory says is implicit in the emotions of suckling and coitus, for the female is described as playing the part of the animal which the young must learn to kill for food and which the male meanwhile must obtain "in plentiful supply" for the young.

Suckling and coitus have been described by the psycho-somatic theory as having a straightforward primitive meaning, just as "Totemism is a thoroughly practical system designed to meet the everyday wants of the ordinary man in a clear and straightforward way" (Frazer, 1910e).

It is of interest that in totemism the animal from which the tribe believed it was descended was ceremoniously killed yet was held in mortal fear. This

ritual resembles closely that of suckling and coitus as described in the theory of this paper.

It is now propounded that the totem ceremonies were the first primitive, unconsciously motivated attempt at a symbolic sexual life for the community. The tribe as a unit, and not as a collection of families, has no sex life of its own to express the love of one member of the unit for another, and borrowed in symbolic form the womanly identification with animals, around which to form its ritual. There was thus acquired for the tribe the sexual symbol of the woman of a family, and around this symbol was dramatized the powerful instinct of the herd. In so far as totem ceremonies developed into the sacrifice of animals in religion, the same emotions and symbolic significance may be discerned also in the latter.

Children also recognize a value in animal identification, and their enthusiasm for stories and pictures of animals masquerading with human speech and clothes is similarly understandable. The atmosphere provided by their mothers in suckling is thus preserved for them. The mother therefore is to the child those animals with whose behaviour the child must at one time become familiar, and within her sheltering tuition the little child is safe. This aspect of the child's relationship to its mother is therefore similar to the prophecy of Isaiah—"The wolf also shall dwell with the lamb, and the leopard shall lie down with the kid; and the calf and the young lion and the fatling together; and a little child shall lead them."

Hall concludes, says Ellis (1928g), that the fear and love of fur in children, in some cases appearing as early as the age of 6 months, "are so strong and instinctive that they can hardly be fully accounted for without recourse to a time when association with animals was far closer than now . . ." That this feeling for fur should still be prominent, after such long evolution, in the human child of six months can be attributed to the mother playing the part in suckling of this primitive furry animal of another species, and thus stimulating the "instinct" in the child for animals. It is presumed that the mother also carries this atmosphere of suckling into her motherhood of the child after weaning.

It is evident, therefore, that the idea of animal identification is embedded so deeply in human minds that it is of value to have a simple explanation for it in suckling and coitus, as given in the psycho-somatic theory of this paper.

The first sublimation by the child of animal identification is on to the father. That animal ideas should be interpreted as "father figures" is a transfer of affect from the mother. It is a tribute to the domestication of the father. In consequence with the popular view of the father as a strong man who exerts discipline, it is usually he that is thought to be the fierce animal of the superior species.

Klein (1932i) says that "In his paper, 'Nach dem Tode des Urvaters' (1923), Roheim argues that through having devoured the corpse of their primal father his sons came to look on him as the nourishing mother. In this way, he thinks, they transferred the love which they had hitherto felt for their mother alone to their father as well." Evidently the same acceptable con-

clusion of transfer of the attachment of a portion of affect from mother to father, but derived from a pathological premiss!

It may be inferred from the psycho-somatic theory that the baby is wishing to share with the father that love which primitively was for the mother. The boy and girl fear the father, pretending he is a member of a superior species, and are aggressive towards the father, pretending he is a member of an inferior species, and thus the children come some way towards loving him as they do their mother, in terms of the educative influence of animal identification.

We have the same normal identification with animals of women when they are called by the numerous endearing pet names of animals and birds. The same displacement made by the child of its identification of the mother with an animal to identifying its father with an animal is made in common parlance by people of all ages when men, by courtesy, are likened affectionately to animals.

Primitively there is no anomaly in the animal identification of women. It is a primitive means to a primitive end. When the primitive child and primitive man identifies the woman with an animal, it is in order to learn and demonstrate respectively a vital primitive concern with those animals. Although our sexual life is primitive, civilization is far from being primitive, and the animal identification of women therefore appears anomalous from the civilized point of view and is sublimated. A civilized mother identifies herself, therefore, with the civilized interests of her husband and children. The animal identification is thus sublimated to conform with the normal interests of civilized families. The more complicated the interests of the children and husband are, the more complicated is the woman's identification with the objects of their interest.

(b) *Psycho-pathology of Animal Identification.*

The psycho-pathology of animal identification occurring in human beings consists of the confusion of the animal itself with the person who is identified with the animal. The objects to be killed and mortally feared in primitive reality are the animals of the inferior and superior species, and these objects are confused with the object to be loved, which is the woman, who, for the benefit of the children in suckling and the husband in coitus, portrays the family's primitive interest, namely, animals of other species.

This confusion in apprehension of the object to be killed is present in the literature on sex, and also in many well-recognized examples of human folly.

The subject will be considered in animals, children, adults and nations.

Animals.—Ellis spoke of anger and fear against weaker and stronger "rivals" respectively, but he did not differentiate clearly the difference between the "rival" to the family's life of a member of another species and the rival to mating of another member of the same herd: the former is the fundamental situation portrayed in sex, the latter when ending in killing is a primitive example of confusion of the object to be killed, and is the antecedent of much inter-human strife.

Children.—Klein (1932j) makes this statement:

"As the work of analysis proceeds we find that the child's relation to reality,

at first so feeble, gradually gains in fullness and strength. The small patient will begin, for instance, to distinguish between his pretence mother and his real one, or between his toy brother and his live one. He will insist that he only meant to do this or that to his 'doll' brother, and that he loves his real brother very much. Only after very strong and obstinate resistances have been surmounted will he be able to see that his aggressive acts were aimed at the real, human object. But when he has come to understand this, young as he is, he will have made a very important advance in his adaptation to reality." It would be more understandable to say that by uncovering a desire to kill the real human object, the way is left clear for a very important retreat from murder in his adaptation to reality. It would appear from the psycho-somatic theory of this paper that the boy was right when he insisted that he only meant to do this or that to his "doll" brother, and that the psychoanalyst was wrong in not recognizing the essential value of the boy's insistence. It is no part of normal reality actually to wish to kill one's brother or mother. It is "reality" to wish to kill a member of an inferior species and to practise this on a "pretence mother" or, as a surrogate, on a "toy brother." When this instinct is turned on to the "real mother" or "real brother" it is a perversion, a racial suicide, and it is not a normal biological reality for the human race. For the bee, with its particular specialized society, the actual death of the male in coitus is established biology, but murder has always held an uneasy place in the human race. It would appear that the "pretence brother" is at times unfortunately confused with the real brother, but that to recognize the folly of such confusion is "a very important advance."

The confusion of the object for anger and fear is found in the oedipus complex. One admits the child loves the parent of the opposite sex, that this love is sexual is very natural, and it is, therefore, inescapable that this primitive love is felt in terms of killing and fear of death. That is normal, if primitive, psychology; but when the anger and fear is attributed to a desire to kill or avoid death from the jealous parent of the same sex we are dealing with a rationalization.

The confusion of thought is clarified by the psycho-somatic theory. The normal and fundamental dissociation of psychology is the woman's expression in sex of her identifications, instead of expressing her own personality. But there would appear to be a pathological tendency to dissociate the woman's identifications from her sexual loving and to displace her identifications to another human being's personality. Thus, in the oedipus complex the boy wishes to kill and fears mortally the real father, instead of the mother's identifications. In the electra complex the girl fears the mother will kill her father, instead of accepting these tendencies of fear and killing in other animals as those of her identifications, assumed in sexual pretence for expressing her love to her father. These incest wishes must needs be repressed, but psychoanalysis has shown that with the repression there is often an oedipus or electra complex, which may be interpreted by the psycho-somatic sexual theory as based on pathological dissociation of the animal identifications of woman.

The normal sexual dissociation of woman occurs by her depersonalization and her sexual identifications. The abnormal dissociation occurs when she

or others expect her to express her own personality sexually and regard the animal characteristics as dissociated from her to another person, who is regarded as being actually vengeful, as in the oedipus and electra complexes.

If the sexual depersonalization of a boy's mother is misunderstood by him as an unwillingness for her to love him or an inability for him to love her, there is present within him a pathological premiss from which he may conclude unconsciously the rationalizations of the oedipus complex. Similarly with the awakening within the girl of love for her father; if she mistakes her sexual depersonalization for an abnormality, she may fear a loss of love which she may attribute quite mistakenly to a malevolence of her mother.

Adults.—Here also the principle of animal identification is too often misunderstood. Van de Velde is correct when he speaks of sexual hostility between man and woman, but the hostility is not, as he says, "primary," for it is secondary to the hostility felt for other species; nor is the hostility between man and woman "genuine" normally, for it is merely the portrayal within the family of its relationship to the environment. When the sexual hostility is misunderstood in marriage, the partners regard each other with a "genuine" psycho-pathological hostility and a marital quarrel ensues.

Woman misunderstands the value of the anomaly when she does not like the sexual act discussed, and when, in order to rid herself of recognition of her bestial sexual identification, she is so ready in projection to call the man a beast. Perhaps it has been on account of her bestial identification that she has in times past been most curiously denied as having a soul, for a soul has been regarded as the exclusive possession of human beings.

Weininger (1906b) says that woman has no mind; in so far as he is referring to the personality of a woman he is incorrect, but in so far as he means that woman does not express her personality sexually he is in agreement with the psycho-somatic theory for, according to this theory her sexual part lies in conveying to her young the nature of the environment and to her mate her ability to do so. She thus encourages her young and charges her husband to address themselves to the environment.

When animal epithets are used as terms of abuse it is presumably to point out an alleged wrongful use of animal identification. It is not that the animal identification is wrong, but that someone is alleged to be misusing it.

A serious failure in the use of the anomaly is found in psychotic patients, who at times have pathological ideas of animals associated with symptoms of unconscious sexual significance; the animal ideas are declared frankly or are projected in hallucinations.

Nations.—The confusion in the use of the anomaly is found amongst nations, for in war mankind is killing his own species instead of an inferior one, and fearing his own species instead of a superior. The sexual dramatization of the enemy is confused in its real fulfilment with others of the human race, who are regarded as "the enemy," "inhuman," and fit to be treated only as being of another species. If the psycho-somatic theory be true, animal identification is intended only for the purposes of love and friendly intercourse, and identification of another nation with an animal should serve the purpose

of identifying it with the objects of one's own civilized interests. War is therefore a psycho-pathological form of the anomaly.

It behoves us to know what we are doing in sex and to understand the animal identification contained therein.

Ambivalence.

(a) Normal Psychology of Ambivalence.

The psycho-somatic theory is an explanation for the finding of the co-existence of primitive emotions and sex by many investigators, of whom have been mentioned Ellis, Darwin, Tiller, Hamilton, Bingham and Zuckerman in animals, Crawley and Roheim in primitive people, Klein in the phantasies of children, and Nietzsche, Weininger and Freud in adults.

Freud, however, does not appreciate the portrayal of the aggressive instinct as an essential primitive element of the sexual instinct, for where aggression is present in sex he appears to regard it as a combination of an aggressiveless sex instinct with the aggressive instinct.

Freud (1933*d*) has said that when "the efforts of the pleasure-principle come to nothing," which he styles a "traumatic" factor, that the libido is turned into anxiety. This is a half-truth, for the sexual libido is itself a demonstration of anxiety which is not noticed unless there be a "traumatic" factor. It is not just that "what one fears is obviously one's own libido," but also that the sexual libido expresses anxiety and is, itself, fearing.

Freud's (1933*b*) later explanation was further still from that of the psycho-somatic theory, for he said that "anxiety never arises from repressed libido," but that it is the ego which feels the anxiety. He retracted his earlier statement that there is a direct transformation of libido into anxiety; according to the psycho-somatic theory of this paper Freud's first thoughts were correct, but he could not pursue them and retracted them, for he had not analysed the nature of the libido, nor discovered its qualitative factor.

"And now the instincts in which we believe," says Freud (1933*e*), "separate themselves into two groups; the erotic instincts, which are always trying to collect living substance together into ever larger unities, and the death instincts which act against that tendency, and try to bring living matter back into an inorganic condition." The death instinct of Freud is not here discussed, except to note that although he separates it from the erotic instincts, there is a portrayal of death by all concerned in suckling and coitus. In this sense the "death" instincts are also trying to "collect living substance."

Freud (1933*f*) says, "Even punishment-dreams are wish-fulfilments, but they do not fulfil the wishes of the instinctual impulses, but those of the critical, censoring and punishing function of the mind." Yet, with the desire for "fear" and "death" present in the sexual instinct and awaiting sublimation, one presumes that Freud is wrong in his assessment that the wish for punishment does not fulfil the instinctual impulses. It is this fear, enshrined in sex, which is so usefully ready for displacement to fear of punishment in social conditioning.

The distinctive explanation of the psycho-somatic theory for the ambi-

valence of love can be further demonstrated. Thus Freud (1925*b*) says, "The relation of hate to objects is older than that of love"; but it is deducible from the theory of this paper that if by hate is meant the desire to kill, it has been co-existent with love from time immemorial.

Zuckerman has suggested that the association in monkeys of sexual activities with fear and aggression is a social conditioning. The psycho-somatic theory of this paper is that the "conditioning" of sex with fear and aggression has taken place ever since fear and aggression were in the world.

The meaning of ambivalence thus established there is an important clinical deduction. Freud's outlook justifies catharsis and an attempt at removal of unconscious aggression and fear from sexual love; this would be excellent were it not that the primitive sexual acts of suckling and coitus as described in this paper make a mockery of catharsis of their emotions and render any such attempt futile. Freud has not appreciated that the erotic instincts are a loving demonstration of the primitively necessary instincts of aggression and fear. Reliving emotion may, on the other hand, have its uses where it is not directed towards purgation of the emotion, but towards acceptance and reorientation to the emotions aroused.

Jones (1938*f*) describes abreaction as "the process of working off a pent-up emotion by living through it again in feeling or action." There is no doubt that good may ensue from what is called abreaction, but it would appear from the psycho-somatic sexual theory that it is the unsatisfactory orientation to the emotion which is "worked off," while the emotion itself is accepted and "worked in" to a better orientation.

It behoves one to give the normal aggression and fear a primitive expression in suckling and coitus and otherwise a sublimated expression.

Ambivalence will be related to primitive people and to the emotions of babies, children and adults.

Primitive people.—The theory gives a biological explanation for the paradox of the killing and eating of the totem parent and for the mortal fear in which the totem is held.

Marro's belief that the presence of force in the courtship of savages is to allow the female to test the man's virility is a similar example of this ambivalence.

Babies.—The reason for the appeal of the story of Red Riding Hood in which the child is in danger of being eaten by its "grandmother" is clearly evident. Riviere's conception of a baby displacing its "horrible phantasies" of a cruel mother on to animals by the use of the "totemic" mechanism is near the mark, but is somewhat confused, for both the "totemic" mechanism and the baby's "phantasies" are derived from the mother, who naturally and very kindly portrays the fierce primitive animal.

Thus the vigilant mother who has prevented her young child from running to its death under a passing bus, smacks it as she shamelessly declares, "I could murder you." Out of her love she wishes to impress the necessary fear of death in her child, and the child is thus comforted that it has learnt so securely something more of the danger of life. Thus, too, does an animal encouragingly cuff its young. And this is the biological explanation afforded

by the psycho-somatic theory for the concept of Isaacs (1933) of the "good-strict" parent.

Freud (1930) says "This instinct (of aggression) . . . is at the bottom of all the relations of affection and love between human beings—possibly with the single exception of that of a mother to her male child." Freud had obviously not appreciated the essential love element of aggression in a mother to her male child or he would not have made an exception where he was presuming love to be unusually strong.

The baby is also exercised in aggression. This not only confirms Freud's beliefs in the internally generated need of the baby to express aggression, but also adds that the aggression is cultivated by suckling.

Thus a mother's reaction to some unusual success achieved by her child is to say "I was tickled to death"; she is content to the primitive foundations of her mind, and there the child's success is felt as "killing." She still feels as she did in suckling when the child learned this livelihood on her and she says "I feel tickled to death." She gives expression to the symbolic feeling of death, although she is happy and in blooming health.

Hence is the ease with which a mother's and the baby's equilibrium shifts to a distressing exhibition of fear or anger. This is normal psychology so long as the emotions are used towards the successful re-establishment of equilibrium, when the exhibition of anger and fear is no longer distressing but pleasant.

The ways in which the sexual instinct and its social expression can be thwarted are fairly numerous, and when an instinct is thwarted its emotions become more apparent. McDougall (1940b) says, "We do not become explicitly aware of our emotions, so long as we give ourselves wholly to action"; and he says of conation as a mode of experience, "We experience it in the most distinct manner when we are moved by some uncontrollable craving or desire which we cannot satisfy and which will allow us neither to rest nor to turn our attention to other things."

One does not deny that a thwarted baby is angry or frightened, but the anger and fear do not spring from the thwarting or separation which merely removes the object (the mother) of the anger and fear. Violent emotions are normally fulfilled in love of the baby, and the purpose of the violent emotions is achieved in the welfare of the baby, when the mother returns to it or when education guides these primitive emotions, where necessary, into socially acceptable sublimated expression. When, however, this mechanism breaks down the instinct is again thwarted, but psycho-pathology does not ensue if the emotions are put into some other acceptable channel.

One does not deny that jealousy of sexual love in others does not show normally as anger and fear in a baby, but, when present, it is more likely to be an irritation aroused by the mother continuing to demonstrate to the father in coitus her willingness for duty on behalf of the baby, when the latter is itself keen to practise the same primitive act of killing on the mother in suckling, in the absence of the father away hunting! There is also the pressing desire of the baby to learn from the mother what the fearful danger is that the father is risking while hunting. It is then not the thwarted desire to kill the

real father, but the thwarted desire to "kill" the "pretence" mother in suckling that is felt in the anger of the baby's jealousy. There is not the fear of the father, but the fear of the external dangers which he so willingly encounters, and which the primitive young can only learn by receiving their direct loving application in suckling from the mother or in play with either parent. The baby's normal jealousy of the coitus of its parents is therefore often just a demand for the satisfaction of the same emotions in suckling or play.

Children.—One does not think an angry or a frightened baby is immoral or unseemly, for a baby is a primitive thing, but it is the object of the latency period to wean the child from the breast, and also from the primitive expression of these instincts to adequate sublimations and so to a recognition of the principles of peaceful civilization. With the repression of sex in the latency period is inculcated in the child a conscious belief in the immorality and wrongfulness of the presence of anger and fear in the world. The child is then taught to eschew violence, is shielded from fear, and is discouraged officially from conscious knowledge of such hidden instincts. The hope is thus established that the child will be fitted for a peaceful civilization, by the sublimation of anger and fear.

Adults.—After the lull and relative innocence of the latency period of childhood, coitus, or the biological preparedness for coitus, reawakens the primitive instincts of killing and death.

The psychoanalytic theories which explain anxiety of adult sex by regression to archaic multiplication by fission and to birth trauma are outside the scope of this article. The theories, however, which describe anger and fear in the adult by regression to babyhood and childhood are appropriate for discussion.

Glover (1933) associates aggressiveness in the adult with sexuality, but by regression to infantile aggression of "children up to the age of five," for "the instincts giving rise to war phenomena belong to that period and to no other." The psycho-analytically described mechanisms are used later to explain the killing and death found along with adult love. One admits that these particular psycho-analytically described mechanisms exist, but they are rationalizations, for according to the psycho-somatic theory of coitus the immediate explanation for the association of killing and death with love in the adult is to be found in coital preparedness, and there is no need to explain anger and fear in the adult by regression to childhood, except in so far as childhood experience modifies the character of the personality. Coitus, and the biological readiness for it, combine "killing," "death" and love, even as does suckling.

One does not doubt that sooner or later the baby's emotions in suckling are displaced to coital precursors (Klein says the oedipus complex starts at six months). Anxiety in the adult male is thus frequently linked by the psychoanalysts with a castration complex arising from infantile incestuous wishes. In regard to the infant's phantasy of coitus or the adult's experience of it, the psycho-somatic theory of this paper is in agreement with the view of the psychoanalysts (though not with some of their explanations) that associated with the emission is fear of death; and the theory is in agreement with the emotional changes at and after the orgasm noted by Callenus, Ellis and Maeter-

linck. We have here a primitive instance within the family of a moral action which is also valued in the community. It has been said that greater love hath no man than this that he lay down his life for his friends—this is analogous to the duty of the primitive male to his family which he portrays in his orgasm, for he must be willing to risk death, if it be necessary, whilst seeking food and life for the young. In peace this primitive readiness to sacrifice oneself must find sublimated expression.

It should be noted that the reversal at the orgasm by the male and female of the emotion with which each commenced the act is normal psychology. The balance or equilibrium of each individual's emotion is thus restored. The psycho-somatic theory therefore adds weight to the importance usually attributed to the orgasm, and explains the phenomenon of the ambivalence of anger and fear.

(b) *Psycho-pathology of Ambivalence.*

Psycho-pathology of ambivalence is present when anger and fear are not recognized as normal channels of love. Thus it is psycho-pathology to explain anger in the baby by fear, or fear by anger, for both are emotions of instincts which are receiving their first cultivation at the breast.

Fear and anger in the baby are not therefore primitively a pathological state of affairs, and the aggressiveness of the mother is not normally just a projection in phantasy of a guilt-ridden child, it is part of the training of the young for an insecure environment and it should not be lost sight of that the baby is nurtured normally in loving symbolic killing and death.

When the baby is not led normally to value its own aggressiveness it projects it on to the mother in phantasy. Riviere (1936c) speaks of the baby's phantasy of the mother having "a cruel breast" and also of a "good breast," but one cannot agree when she says, "The next aim of psychic phantasy is then to keep these two images separate and distinct; if they are allowed to merge, clearly a good breast which is also cruel and vindictive has ceased to be good." Such a "cruel" breast has not, according to the psycho-somatic theory of this paper, ceased to love, nor is it a phantasy of the baby.

This psycho-somatic theory has further clinical implications. Thus if we consider the statement of Klein (1932k): "According to my observations, the reason why the child needs to have its mother always with it is not only to convince it that she is not dead, but that she is not the 'bad,' attacking mother." Both the observations of Klein are a misunderstanding either on her part or the child's, and normal psychology has been misunderstood as psycho-pathology, for the normal baby wishes the mother to be "dead" when she portrays the inferior species, and the baby needs the "bad" attacking mother, who teaches it the danger to be expected from the superior species.

The fierce emotions practised in love by suckling are meant to breed confidence in the survival of the species. This confidence is shared by civilized mothers and their babies, but when, as so often happens, the instincts are thwarted, there are left unfulfilled most uncivilized emotions. The frustrated emotions may then impinge on the rest of the psyche in other than loving ways.

The "floating" emotions are often rationalized, and it is the rationalizations which the psychoanalysts have detected.

And it is psycho-pathology to attribute too much of the fear and anger found in the baby to the third party of the oedipus complex, for, in so far as there are coital emotions in the baby or child, the fear and anger will have the same normal and essential significance as in the adult.

Actual incest is pathological, but an unconscious incest wish is most natural. A mother is her boy's first sweetheart, it is said. The application in unconscious phantasy of the emotions to the parent of the opposite sex is harmlessly childish and forms a safe repository for these emotions until marriage, but when a murderous jealousy is felt for, or imagined in, the parent of the same sex, then the incest wish has developed psycho-pathological associations. Similarly the complex of the boy that his father will castrate him is psycho-pathology. Catharsis of such a concept is appropriate, but psycho-pathology persists unless it is recognized that disguised in the castration complex is the previously described normal and essential meaning of the emission, which must be accepted and sublimated to a normal concept instead of the concept of castration.

The psychoanalysts attribute too much of adult psycho-pathology to maladjustments of the incest wish in childhood. The same maladjustments to sex arise in the adult, so that neurotic and psychotic anxiety and aggressiveness are attributable to present sexual difficulties and not only to regression. It is always advisable to explain symptoms in terms of the present situation as well as in terms of regression to misunderstood infantile incestuous wishes. Freud indeed explains anxiety neurosis in terms of the current sexual life, but owing to ignorance of the meaning of the sexual act he could not pursue this subject far, and he set the course for infantile regression theories to the too great exclusion of the current sexual disposition of the patient.

Three examples of a misunderstanding of the current sexual disposition in coitus, maternity and paternity will be given.

Murder of a spouse is a crude example of the psycho-pathology of the ambivalent emotions of coitus.

In the neuroses and psychoses of lactation a mother's equilibrium shifts to suicidal and infanticidal feelings, which are obvious displacements of the same emotions found normally in a mother as described in the section on normal psychology of ambivalence.

The simplest example shown in fathers of the psycho-pathology of ambivalence is war. Man goes to war; he is redeeming his primitive sexual pledge to woman that he will go forth to kill. Coitus conditions him still to kill and to delight in mortal danger, but the environment is subdued already and no other species threatens him seriously. Instead of adequate sublimations he slays the members of his own species, thus manufacturing his insecurity from his kith and kin and laying himself open to disaster. A nation, when attacked by an aggressive nation, defends itself by war in order to avoid a worse psycho-pathology, and thus is condemned to psycho-pathology of civilized fatherhood.

The above three examples are of the simplest and crudest aberrations of the emotions fostered by sex. Much of psycho-pathology consists of a more

disguised failure in the understanding, acceptance and sublimation of the emotions of ambivalence. Such, for instance, are the symptoms described by Adler of a pathological "will to power" and the "inferiority complex."

A sense of both power and inferiority is kept alive in both sexes by our primitive suckling and coitus, which portray the relative power and inferiority of one species to another. The origin is not in sex, but in the order of superior and inferior species which everywhere exists. This situation is portrayed between members of the same species, and in this portrayal power or inferiority do not belong more to male or female as is supposed by Adler. "Organ inferiority" and the "helplessness of a baby" exist, but they, too, easily become a rationalization for a misunderstood sexual portrayal of inferiority.

Jones (1938g) says that "The real source, as always with inferiority feelings, is internal forbiddenness because of guilt and fear . . .," but according to the psycho-somatic theory the sexual sense of inferiority is intrinsic in everybody. "Forbiddenness because of guilt and fear" may well be the source of our noticing the inferiority feelings in an unpleasant way, and thus be a disguised misunderstanding of our primitive sexuality.

E. CONCLUSION.

A psycho-somatic theory has been presented of suckling and coitus. The theory is definite and fundamental, and gives a qualitative factor for the biological and psychological understanding of sex within the family. The normal primitive psychology of the family has been described as love demonstrated by "animal identification" and "ambivalence."

It has been shown briefly that there are important social, religious and clinical phenomena which may be interpreted by the psycho-somatic theory of sex, but the further elucidation of these has been left for other papers.

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A STUDY OF MENTAL DERANGEMENT IN AFRICANS, AND AN ATTEMPT TO EXPLAIN ITS PECULIARITIES, MORE ESPECIALLY IN RELATION TO THE AFRICAN ATTITUDE TO LIFE.

By J. C. CAROTHERS, M.B., D.P.M.

INTRODUCTION.

THIS article is a study of mental derangement in Kenya Africans, and is based on seven years' special experience as Medical Officer in charge of Mathari Mental Hospital and of H.M. Prison, Nairobi, and on nine years' previous general medical experience as a Government Medical Officer in various parts of the Colony.

This experience has provided an opportunity of studying the African's attitude to life, the relation of this attitude to insanity in the African, and some possible bearings of this on the aetiology of mental reaction types and of insanity in general.

The need for such a survey at this time is enhanced by the fact that the African is going through a period of cultural transition ; his native institutions are decaying, and he is rapidly acquiring an attitude that approximates to that of the European, so that such a study will become increasingly complex with the passage of time.

The investigation that follows is mainly based on Africans certified insane and admitted to Mathari Mental Hospital (the only mental hospital in Kenya) during the 5-year period from 1 January, 1939 to 31 December, 1943 inclusive, and it should be stated that where a patient was readmitted within the period he is only counted once. The total number so admitted was 736, but three of these showed no symptoms or history suggestive of mental derangement, 16 were admitted solely on account of mental deficiency, 62 were admitted from native regiments passing through the Colony from other territories, and 46 were not admitted for the first time during the 5-year period. For purposes of comparison with British and American figures in my possession, our study is therefore limited to 609 Kenya Africans admitted for the first time and mentally deranged.

A further complication has arisen since the outbreak of war, as a certain number (unknown to me) of military insane have been dealt with at military hospitals as well as at Mathari. So that, for purposes of discussion of total and sex incidence and the influence of detribalization, all Mathari military cases from Kenya (numbering 51) have had to be eliminated, and the total native population of the Colony reduced by the average number of persons serving in the military at any one time. The total number of patients under

consideration in Part 3, Sections a, b, and d, is therefore still further reduced to 558.

During the same period, 165 European and Asian patients were admitted, but these will not be further discussed except on a few occasions for comparative purposes.

Arabs have not been counted in either of these categories. As Seligman says, "In Africa the term Arab may be applied to any people professing Islam, however much negro or other foreign blood may run in their veins, so that while the term has a cultural value it is of little ethnic significance and often is frankly misleading." Persons calling themselves Arabs have therefore been entirely ignored for the sake of simplicity.

The article falls into eight parts: first, a short summary of the historical background; second, a short summary of the racial and anthropological background; third, a short summary of the public health background; fourth, a description of the facts in regard to mental derangement occurring in Kenya Africans; fifth, a tabulation of the more striking peculiarities of mental derangement as compared with such derangement in Europeans and in American negroes; sixth, a description of native culture, thinking and attitude to life; seventh, an attempt to explain the peculiarities of mental derangement listed in Part 5; and eighth, a short general conclusion followed by a summary.

I. THE HISTORICAL BACKGROUND.

A few words are required on the history of Kenya, mainly to demonstrate the duration of influence of alien cultures on its inhabitants. The word "Kenya" is used throughout for the sake of brevity, though in fact this has only become the name of this part of Africa since 1920.

There must be few parts of the world, or of Africa, with a shorter certain history than Kenya. No written records have been kept by Africans themselves, and such early history as relates to the interior is purely a matter of myths and stories handed down within each tribe, and only reliable for a few generations back. In the words of Professor Coupland, referring to the interior of East Africa prior to 1856,—“a curtain falls, shrouding the vast interior of the continent in impenetrable darkness.”

These remarks are not true of the coast however, which does have an ancient history. In brief, from prehistoric times until about 700 A.D. Arabs, mainly from Oman and the Hadramaut, traded all along this coast and from that date onwards established settlements at all its anchorages. Their sole object was trade, the main items of export were slaves and ivory, and their only effect on the interior was to encourage inter-tribal feuds (for the capture of slaves), and thus depopulate the country and indirectly but very effectively maintain its backwardness. For a period from 1502 to 1698 the Portuguese obtained control of the Arab ports, but in effect they merely replaced the Arabs as middlemen in the commerce of the coast and, when ousted in the latter year by the Arabs, had left practically no mark on the life of the country. In 1698 the Arabs regained control of the coast north of Cape Delgado and re-established their ancient commerce. In 1840 Seyyid Said, sultan of Oman, transferred his court from Muscat to Zanzibar and, from that date until its

final suppression in 1876, the slave trade from the coast rapidly increased, and the field of Arab exploitation was extended throughout Tanganyika to the great lakes and beyond. Further north however, the hinterland, except for a few miles round Mombasa, remained almost unknown, and the export of slaves and ivory little greater than before. By the time of the partition of East Africa between England and Germany in 1886, the sole effects in Kenya of Arab settlement had been the hybridization of a narrow belt of people along the coast and their introduction to Islam and to a certain stilted type of oriental courtesy, and on the interior a vague fear and respect for light-skinned strangers with guns.

European exploration and influence began with the establishment of a C.M.S. mission by Krapf at Rabai, near Mombasa, in 1844. The outstanding events of the next 44 years were shortly as follows: In 1851 Krapf explored the Kamba country as far as the border of Kikuyu-land; in 1862 the Methodists established a mission at Ribe, near Rabai; in 1878 the Denhardt brothers explored part of the Tana river; in 1883 Fischer travelled from Pangani to Lake Naivasha via Arusha, Thomson travelled from Mombasa to Lake Victoria via the Kenya highlands, and the C.M.S. established a mission at Teita; in 1884 the Methodists established a mission on the lower Tana river; in 1886 partition of East Africa was effected between England and Germany, the former taking the country now known as Kenya Colony; in 1888 a charter was granted to the Imperial British East Africa Company, who established their headquarters at Mombasa and made treaties with the Nyika, Teita and Kamba tribes, and in the same year Count Teleki discovered Lakes Rudolf and Stefanie. By 1888 therefore the main geographical features of Kenya had been discovered, but missionary and other European influences were still limited to the coastal belt, and very locally at that.

The opening up of the interior began with the establishment by the Imperial British East Africa Company of a trading station at Machakos in Kamba country in 1892. From this date onwards the Company developed trading posts here and there in Kenya, and various mission stations were established in Kamba country. In 1895 Indian traders were invited to Machakos, where they opened shops and introduced the rupee to the interior of Kenya—all previous trade having been by barter. In this year also a protectorate was declared over British East Africa and the Company relinquished its charter. Between 1895 and 1902 the Kenya and Uganda railway was built. Between 1900 and 1920 most of the existing mission stations were established, Europeans bought farms throughout the "settled areas," Indians opened shops throughout the Colony, and Kenya acquired substantially its present character.

Until about 1890 therefore the peoples of the interior were almost completely untouched by any alien influence, and were living presumably as their forefathers had lived for countless generations. There is not even any record in Kenya of the development of native kingdoms such as occurred in West Africa, Uganda and Tanganyika, and this in turn may be related to the minor part played by the slave trade in this country, as it has been suggested that African kingdoms have arisen as a defence in war, especially the slave wars.

Finally, European influence only began to be important about 1900 and,

though it developed rapidly from that time onwards, its development has been very uneven. So that at the present time certain tribes (such as the Kikuyu, Nandi, Bantu Kavirondo and Jaluo) have experienced a relatively long and close contact with this alien culture, whereas others (such as the Turkana and Masai) remain almost untouched.

2. THE RACIAL AND ANTHROPOLOGICAL BACKGROUND.

The part of Africa now called Kenya Colony stands on what has been for hundreds and probably thousands of years the main highway of Hamitic infiltration into negro Africa on its eastern side. This country has therefore for long been one of the chief racial melting-pots in Africa, and every type from pure Negro to pure Hamite can to-day be seen.

The true Negro, according to Haddon, has a black skin, woolly hair, a flat broad nose, thick, often everted lips, often considerable prognathism, a tall stature averaging 68 inches, and moderate dolichocephaly with an average cephalic index of 74 to 75. The true Hamite on the other hand has a light skin, wavy hair, a projecting narrow nose, lips often thick but never everted and no prognathism; the height and head shape vary considerably in different tribes, though the Somalis (the chief Hamites in Kenya) show an average height of 68 inches and a cephalic index of 75.

These pure types are in fact comparatively rare in Kenya, are only seen in scattered individuals, and no tribe within the Colony could be described as either true Negro or true Hamite. The great bulk of the native population falls somewhere between these two extremes, and though there are at least 60 different tribes, the Kenya African can be broadly classified into five large groups.

These groups are shortly described below but, as none of them has been comprehensively studied on anthropological lines, the descriptions make no claim to scientific exactitude. Nevertheless the differences are real enough to the experienced observer, and no one who has lived long in Kenya would be likely, for example, to mistake a Jaluo for a Somali.

(a) *Bantu Negro*.—The separation of this group from the others was based primarily on linguistic considerations, as all Africans living south of the well-known Bantu line, which runs in an irregular manner from the mouth of the Rio del Rey in West Africa to the mouth of the Juba River in East Africa, speak closely related "Bantu" languages.

But although the Bantu were primarily delimited on linguistic criteria, it has been found that the title implies much more than a common language and that, at least as far as Kenya is concerned, their physique and culture are also closely related.

The Bantu peoples of Kenya are slightly Hamiticized Negroes and their physical characters are mainly negroid (as above described), but with a variable though usually slight admixture of Hamitic characters. Thus, though the hair is almost invariably woolly and the lips thick and everted, the nose is often quite narrow.

They are mainly agricultural, peace-loving, attached to home, and by

religion pagan, though an ever-increasing number of the younger generation are becoming Christianized.

They number about 2,225,000 persons, and the largest tribes are the Kikuyu (634,000), the Kamba (453,000), and the Meru (205,000).

(b) *Nilotic Negro*.—The Nilotes speak a Sudanic language, quite distinct from the Bantu languages, their centre (according to Seligman) being “the Anglo-Egyptian Sudan, where they constitute by far the strongest of the ethnic units into which the blacks of the Nile Valley can be divided.”

The most typical representatives of the Nilotes—the Shilluk and Dinka of the Sudan—converge more closely than the Bantu to the hamitic type, but the Jaluo (the sole nilotic tribe in Kenya) are hardly separable on other than linguistic grounds from the Bantu.

Physically, they are slightly Hamiticized Negroes, and if anything more negroid than the Bantu peoples of Kenya, with darker skins, thicker lips, more prognathism and heavier build.

They live by agriculture and fishing, are pagan, and like the Bantu, their young people have a great admiration for European institutions, and are attending school and becoming Christianized in ever-increasing numbers.

They number about 577,000 persons, and are confined to the country round Lake Victoria.

(c) *Half-Hamites*.—Again quoting Seligman, the Half-Hamites as their name implies “carry a considerable amount of Hamitic blood, i.e. definitely more than almost all the Bantu and Nilotes. This relative preponderance of the hamitic side of their ancestry is reflected alike in speech, appearance and culture. They all speak languages of Hamitic type, and although their skins are dark, their faces are generally negroid rather than negro, the difference being especially obvious in the nose. Culturally they are predominantly pastoralists—indeed many of their tribes depend entirely on their herds, leading the semi-nomadic life that this entails.”

In fact Seligman hardly does justice to the good looks of Half-Hamites, in whom light skins are sometimes seen, prognathism is rare, and of whom some are by European standards extraordinarily handsome.

They are aggressive, racially proud, and at least in certain tribes profoundly indifferent to European institutions. Neither European scholarship nor Christianity has much appeal for the Half-Hamites, who are almost entirely pagan.

They number about 375,000 persons, the largest tribes being the Kipsigis (92,000), the Turkana (62,000), the Masai (50,000) and the Nandi (50,000), and they extend in a belt down the central highlands of Kenya from Lake Rudolf in the North to Tanganyika in the South.

(d) *Hamites*.—The Hamites are of Caucasian stock, and in characteristic tribes, such as the Ababda of the eastern desert of Egypt, conform to the Hamitic type as above described.

The Hamites of Kenya however show a slight admixture of Negro elements, so that although their features are fine, their skin is often black and their hair woolly.

They speak a Hamitic language, are predominantly pastoral and nomadic,

are proud, independent and rather vindictive, and by religion are mainly Mohammedan—often fanatically so.

They number about 70,000 persons, the largest tribes being the Somali (40,000) and the Borana (26,000), and they inhabit the Northern Frontier District of Kenya. Somali cattle-men trek vast distances to sell their cattle, and often settle as traders in other parts of the Colony.

(e) *Immigrants*.—This is not a natural group, but is a heterogeneous assortment of Africans who have immigrated into Kenya in recent years from other parts of the continent. They live mainly in the towns, are detribalized, and number about 33,000 persons.

3. THE PUBLIC HEALTH BACKGROUND.

Psychiatry cannot of course be entirely isolated from general medicine, so we have inserted a brief summary of the main public health problems in Kenya in so far as they differ from those found in Great Britain.

Far from being the healthy savage living in an earthly paradise envisaged by early writers, the African living in his reserve is seldom quite fit or free from parasites, and the infant mortality, though unknown, is certainly very high. In areas untouched by our civilization latrines are unknown, flies abound, drinking water is unclean, food is inadequately cooked, and great epidemics of enteric and dysentery are only averted by the scattered nature of the population. The huts, which are overcrowded, have a fire but no chimney, and the atmosphere is such that a European feels faint and sick after a few minutes. The diet is usually ill-balanced, and apt to be lacking in various essential items.

The main public health problems can be described under two heads—(a) Food Deficiency and (b) Infectious Disease.

(a) *Food deficiency*.—The items that are apt to be deficient in the diet, especially among the agricultural tribes, who form the great bulk of the population, are protein of good quality, calcium, and sometimes iron, vitamin A, P.P. factor and vitamin C. Vitamins B₁ and D are rarely deficient.

C. R. Philip in a recent survey of 2,182 school children drawn from various tribes found general undernourishment (as assessed by weight and height measurements) in about 84 per cent., signs of vitamin A deficiency in the "great majority," signs believed to be due to some deficiency in P.P. factor in practically all growing children, bleeding gums which might be attributed to some deficiency of vitamin C in 26 per cent.; an insufficient calcium intake was common if not the rule, and a deficiency of iron, as evidenced by a haemoglobin index under 80 per cent., occurred in 90 per cent.

Pyorrhoea, which is almost universal in adult natives, and ulcers of the leg, of which over 50,000 were treated in Kenya in 1943, are also probably related to food deficiency.

(b) *Infectious disease*.—The following are the chief infectious diseases. The figures are taken from the Annual Disease Returns of the Medical Department.

Malaria is endemic in most areas below about 6,000 feet. In these areas the children that survive infancy acquire a limited immunity. In areas above this level severe and fatal epidemics are apt to occur in wet years. This

infection is accountable for much recurrent ill-health and many cases of anaemia. 55,231 cases were treated in Kenya in 1943, and 293 deaths were recorded.

Dysentery of various types is as common as might be expected in view of the unhygienic habits of the people as described above. 7,493 cases were treated in 1943, and 170 deaths were recorded.

Conjunctivitis, of which 20,717 cases were treated in 1943, is probably related to the prevalence of flies, which often swarm unchecked around the eyes of native children.

Schistosomiasis, a potent cause of anaemia, is especially common in the coastal belt. 1,613 cases were treated in 1943, but this is no measure of its frequency, as the passing of blood-stained urine is hardly regarded as abnormal by natives at the coast.

Ankylostomiasis again is especially common at the coast, and is the cause of most of the severer anaemias seen. 2,596 cases were treated in 1943, but this figure again is no measure of its frequency. It is no uncommon experience at the coast to meet natives with a haemoglobin rate of 40 per cent. or less caused by hookworms, in the course of a routine survey of the population, who are not complaining of ill health.

Taenia and Ascaris are almost universal, but cause surprisingly little obvious ill-health. Of the former 27,072 cases and of the latter 15,023 cases were treated in 1943. The sole species of taenia seen is *T. saginata*, as pigs are quite a recent introduction to Kenya.

Yaws, of which 9,707 cases were treated in 1943, used to be endemic throughout the colony, but is probably being slowly stamped out, and it is becoming increasingly difficult to find examples of the more florid (and infectious) manifestations of this disease. In 1933 the equivalent figure was 14,595.

Syphilis, of which 13,515 cases were treated in 1943, is on the other hand becoming increasingly common. It is probable that this disease was almost unknown in the interior of Kenya before the beginning of the century, and was only introduced in earnest during the last war. Even to-day it is hardly known among certain tribes. In 1933 only 6,205 cases were treated, and the difference between the figures for 1933 and 1943 would be still more dramatic if cases treated at military hospitals (in 1943) could have been included. The subject of the introduction of syphilis to Kenya will be further discussed in Part 7.

4. THE FACTS IN REGARD TO MENTAL DERANGEMENT.

This part is divided into five sections dealing with (a) Total incidence, (b) Sex incidence, (c) Racial incidence, (d) Incidence in relation to detribalization, and (e) The various types of mental derangement.

Age cannot be scientifically discussed as ages are rarely exactly known. They have however been estimated in all cases and are referred to under the various types of derangement, but can only be taken as approximate.

(a) *Total incidence.*—For the purposes of this section all military admissions have been eliminated, and the total population of the Colony reduced by the average number serving in the military at any one time.

558 mentally deranged Kenya Africans were admitted to Mathari for the

first time during the 5-year period. All Africans certified as insane in Kenya come to Mathari so that, with the exceptions referred to in the introduction, this figure of 558 represents the total number of Africans certified as insane throughout the Colony. So 111.6 new cases of insanity are known to have occurred per annum—a rate of 3.4 per 100,000 of the population per annum.

In 1938 in England and Wales 23,153 patients were admitted to mental hospitals for the first time—a rate of roughly 57 per 100,000 per annum. In the years 1917 to 1933 the rates for first admissions for mental disorders to mental hospitals in the State of Massachusetts varied between 72 and 86 per 100,000. This figure includes persons of all races, that for negroes alone being about 161 per 100,000.

The discrepancy between our rate of 3.4 and these British and American rates of 57 to 161 is so vast that we must now consider the possible fallacies in our figure, and the possibility that other cases occur which are never seen at Mathari.

The only possibilities that occur to one can be listed as follows: (i) Are the insane deliberately killed? (ii) Are they housed in other institutions? (iii) Do they simply pass unnoticed? (iv) Are they deliberately thrown out of their homes, or allowed to wander away and die? (v) Are they looked after at home? We will attempt to answer these questions in turn.

(i) It is not impossible that a certain number of congenital idiots may be put away at or shortly after birth, but with the question of mental defect we are not at present concerned. In regard to mental derangement, which hardly occurs before puberty, the answer to our first question is a clear negative. As Medical Officer in charge of H.M. Prison, Nairobi, one examines the evidence in all cases of murder that come to trial throughout the Colony and interviews the prisoners themselves. Among all the cases so seen (about 200) in the 5-year period, no case of murder of a mentally deranged person on account of his being so deranged has occurred. If such a practice existed some cases would surely have come to trial.

(ii) The only other possible institutions are the prisons and general hospitals scattered throughout the Colony. If a person's sanity is in doubt he is taken before a magistrate, who orders his detention in the nearest prison for a period not exceeding 14 days, so that the local Medical Officer may have an opportunity to observe the patient. At the end of this period the Medical Officer either certifies the patient as insane (in which case he is sent to Mathari and included in our figures), or finds him not insane (in which case he is discharged). In fact many (if not most) of the persons discharged *were* temporarily insane, but recovered within the 14-day period. They thus fall into the class of case classified by Neil Dayton in *New Facts on Mental Disorders* as being "admissions without mental disorders," and defined as "persons who exhibited mental symptoms in the community but the attack was of such short duration that, after observation in a hospital, the staff diagnosed them as non-psychotic." As we are only concerned in this article with persons "with mental disorder," and as our comparisons are made throughout with the figures of American Negroes "with mental disorder," these observation cases can therefore be ignored.

Two other types of case that occur in prisons and hospitals remain to be mentioned, namely criminal lunatics, and patients in hospitals suffering from deliria associated with their physical illness. But the former are sent to Mathari anyway (as there is no criminal lunatic asylum), and the latter are no more likely to be detained in the general hospitals than is the case in other parts of the world.

(iii) There is no reason to believe that mentally deranged persons are more likely to pass unnoticed in Kenya than elsewhere. If we were discussing the incidence of mental deficiency the story would be quite different, as the level of intelligence required to pass muster in primitive communities such as those in Kenya is definitely lower than Europe and America, but apart from a few mild dementias and paranoias this can hardly apply to insanity. This question will be referred to again however under the fifth heading of this section.

(iv) This question falls into two parts which are not clearly separable, and the whole question is more difficult to answer and can only be approached in indirect ways.

In regard to the question as to whether insane persons are deliberately thrown out of their homes the following comments should be made: Every individual in an African community plays an important part in that community, has ceremonial and other duties to perform, and is regarded as a valuable asset by his clan. This subject is dealt with in detail in Part 6, and is only mentioned at this stage to make it clear that, unlike in civilized communities, the unwanted individual hardly occurs, and the death of anyone past childhood is the occasion of an orgy of emotional display by all the relations to a far remove.

It is therefore probably rare for anyone to be deliberately thrown out of his home, and no case of its having occurred has come to my knowledge.

In regard to the question whether insane persons are allowed to wander away, it should be said that any sick person becomes the responsibility of his family, and if his sickness takes a mental form and he tends to wander away, his relations would be promptly informed, as everyone in a native reserve is well known to everyone else for miles around. Only if he wandered into a township, or a European settled area, or the country of another tribe would his identity be likely to be lost, and in the former two cases at least he would certainly be apprehended and not allowed to die.

Hence, although it is probably not very uncommon for insane persons to wander away from home and get lost, it is probably rare for such persons to die and thus fail to appear in our records. (In fact, among 100 recent consecutive non-criminal and non-military admissions to Mathari, 12 cases were admitted on account of being found wandering and homeless—6 in an adjacent township or estate, 2 in a train or bus, 1 in an adjacent tribal reserve, and 3 in their own tribal reserve.)

(v) The question whether considerable numbers of insane are looked after at home now arises. It cannot be answered directly, as no comprehensive surveys of the population as a whole have ever been undertaken in regard to this point.

In general it can be said that in *all* cases of unaccountable illness, physical

or mental, it is customary for the African to assume that the patient has been bewitched, the medicine-man is consulted, and by various charms and devices he attempts to remove the bewitchment. As a rule it is only after he has failed that the assistance of alien medicine is invoked, so that one would expect to find that the insane are looked after for a short time at least at home.

A more definite answer can, however, be obtained by a consideration of the circumstances and history of those cases that *are* certified, and accordingly arrive at the mental hospital.

Of our 558 admissions, only 292 certainly (and another 41 probably) came straight from their homes in the reserves. The remainder were certified away from home in circumstances that will be more fully described in Section (d). Accordingly, although about nine-tenths of the population live at home in the reserves, only a little more than half of our admissions come from these reserves.

It is of course possible that the African living at home is much less likely to become insane than if he leaves his home and the protection of his tribal institutions (and this, as is shown later, appears to be true), but the *figures* suggest that a large number of insane are looked after at home.

Of 50 consecutive recent cases that came straight from their homes, 32 were described as exhibiting aggressive and violent or destructive behaviour, 2 abusive or threatening behaviour, and only 16 were merely restless, noisy or unmanageable. In 27 of these cases the period of time for which they were looked after at home before certification was specifically stated. It varied between 1 day and 2 years, and showed an average of $6\frac{1}{2}$ months.

We deduce therefore that it is probably the rule for Africans to attempt to look after their insane relations, that they are only brought in from the reserves if they become unmanageable, and that a considerable number of the more amenable insane are looked after at home.

* . * *

This deduction having been made, a more direct approach to the problem was attempted by enlisting the help of the District Commissioners of the native reserves of Embu, North Kavirondo, and Elgeyo.

These reserves contain a total population of 616,000 persons. All the local chiefs were required to make a census of the insane and mentally deficient persons in their respective locations, and there is no reason to doubt that all the persons known to be insane and mentally deficient in these reserves at the time of the census were counted.

The figure for the insane was 205. If we add to this the number of insane in Mathari at the time and admitted from these reserves the total becomes 228, or about 0.37 per thousand of the population. There might also be a few military insane from these reserves. The equivalent English figure (of patients notified as under care in the mental hospitals of England and Wales in 1938) is 3.9 per thousand. If the same proportion occurred here as in England and Wales there would be over 2,400 insane from these reserves.

Now the figure as produced by the Chiefs is open to the obvious objection that it is based on the non-medical diagnosis of a medical condition. In the

case of insanity, however, with its repercussions on society, this objection is less valid than in the case of most physical diseases, and we have found in practice that the native estimate of a patient's mental condition is seldom entirely false. Nevertheless it is likely that a certain number of simple types of schizophrenia and mild paranoias and dementias have been missed.

The expectation of life of the African, moreover, is likely to be lower than that of the European in view of the high incidence of infectious diseases described in Part 3, so that some of the cases seen in Europeans in later life should be subtracted from the figure of 2,400.

Furthermore, the expectation of life of the insane living in an African reserve is doubtless lower than that of European insane housed in mental hospitals—a consideration that would still further reduce our figure of 2,400. It is within our knowledge, however, that the mentally abnormal are often very well looked after at home; one idiot for instance who could neither sit up, crawl, speak nor feed himself was looked after at home by the Masai, a very primitive and savage tribe, for 17 years before admission!

In spite, however, of these various qualifications, it would appear that the enormous gulf between our figure of 228 and the figure of 2,400 (as estimated from British incidence) remains substantially unbridged; and it is finally deduced that, although no precise figure can be calculated, the incidence of insanity in Kenya Africans (at least in those living at home in their reserves) is probably very much lower than that in Europe or America.

(b) *Sex incidence*.—Of the 558 persons admitted, 367 were men and 191 were women, a ratio of nearly 2 men to 1 woman. If military insane were included the disproportion would be still greater. In the State of Massachusetts, "on the whole six psychotic males are admitted to mental hospitals for every five females." Henderson and Gillespie, presumably referring to figures in England and Wales, say, "The total incidence of mental disorder differs but slightly in the two sexes."

There is thus in Kenya a relatively very large excess of males, and at first sight it might appear that this represented the true relative incidence of insanity in the two sexes. But let us study our material more closely.

Of the 367 men, only 168 were admitted from their homes in the reserves; whereas of the 191 women, 124 came from their homes. Hence a large proportion of the excess of men were living away from home at the time of their certification, and the ratio of men to women coming from home was approximately 4 to 3.

Men on the whole also are less likely to be manageable at home and more apt to be certified. Of the 50 consecutive admissions described in Section (a) 28 were men and 22 were women, but of the former only 6 were not specifically described as violent, destructive or threatening, whereas of the latter 10 were not so described.

For what it is worth, moreover, in the 26 cases in which the period of time looked after at home was stated, the average period for men was 6 months, and for women was 7 months, but the number concerned is too small to be of much significance.

Finally, of the 45 insane persons being looked after at home in the Embu

and Elgeyo reserves, 26 were men and 19 were women. (Sex figures were not shown in the North Kavirondo census.)

It seems most likely, therefore, that the sex incidence of insanity in the reserves is not markedly different from that obtaining in other parts of the world, and that the large excess of male admissions to the mental hospital is directly related to a high certification rate among detribalized Africans.

The sex ratios are described under each of the various types of mental derangement, but will only be commented upon if, after dividing the male admissions by 2, there is still a significant difference between our sex ratio and the American sex ratio for all races—American Negro figures for sex not being available to me.

(c) *Racial incidence*.—The total number of admissions during the 5-year period was 609. Of these, 444 were Bantu Negro—a rate of 4.0 per 100,000 per annum, 67 were Nilotic Negro—a rate of 2.3, 46 were Half-Hamites—a rate of 2.5, 22 were Hamites—a rate of 6.3, and 30 were immigrants—a rate of 18.2.

At first sight it might appear that these figures represented the relative degrees of liability to insanity of the various races concerned. But when one examines the incidence in greater detail—by tribes instead of races—one finds that it varies markedly in different tribes within the major races. For instance, the Kikuyu (a Bantu Negro tribe numbering 634,000) showed a rate of 9.3 per 100,000, whereas the Kamba (another Bantu Negro tribe numbering 453,000) showed a rate of 2.1; the Nandi (a Half-Hamite tribe numbering 50,000) showed a rate of 5.2, whereas the Turkana (a Half-Hamite tribe numbering 62,000) showed a rate of *nil*; the Somali (a Hamite tribe numbering 40,000) showed a rate of 9.0, while the Borana (a Hamite tribe numbering 26,000) showed a rate of 1.5. (The Nilotic Negro race contains only one tribe in Kenya—the Jaluo; and the immigrant people have now largely lost their tribal titles.)

Clearly, therefore, the different rates observed in the indigenous races have no meaning as an index of liability to insanity in these races. There is indeed no evidence of varying liability in these races, and the varying tribal incidence can be better explained in other ways, a matter that will be discussed in Section (d) of this part.

Equally clearly, however, the rate among immigrants is very high—much higher than in any Kenya tribe. Even if the excessive admissions are largely accounted for by the fact that these people live mostly in the larger townships (and so have to be certified if insane), yet it remains likely that the incidence of insanity is relatively high among these people.

This is in agreement with the admission rates of mental patients in the State of Massachusetts, where foreign-born persons show the highest rate, native-born of foreign or mixed parentage a lower rate, and native-born of native parentage the lowest rate.

The racial figures are mentioned under each type of mental derangement, but will only be commented upon when they differ significantly from the total racial proportions.

(d) *Incidence in relation to detribalization*.—From the foregoing it has now emerged that the total incidence of insanity is probably very low, that a dispro-

portionately large number of our admissions were certified away from home, that the large excess of males is directly related to a high certification rate among persons that have left their reserves, and that the certification rate among immigrants is relatively high. All these facts point in the same direction, namely that so long as an African remains at home he is very unlikely to be certified insane, but as soon as he leaves his home his chances of being so certified are much increased.

Now the primitive African has a very definite culture and attitude to life, as will be seen in Part 6—the old idea of the happy-go-lucky uncultured savage has been recognized as false long since. Unlike the Bushman and certain other primitive races, the East African native has however an immense admiration for European institutions and manner of life, so that contact with this alien culture is rapidly destroying his own. The conflicts and difficulties engendered by this tendency might well be expected to be a potent source of mental breakdown, and it is with this aspect of the problem that this section of our article is concerned.

The question of detribalization is, however, a complicated one and might be studied from several angles, i.e. Christianization, secular education, working relationships with non-African employers, relationships with Government officials and with shop-keepers (the latter mostly Indian), life in townships, and the introduction of syphilis and alcoholic spirits and other drugs.

The part played by syphilis, spirits and drugs is discussed under the different types of insanity and, as will be seen, this part is so far small and relatively unimportant, though it is unlikely to remain so for long.

The parts played by Christianity and education are inextricably mingled, and impossible to assess in a scientific manner. The great bulk of the schools of this Colony are Mission schools, where religious teaching plays a large part—indeed if one asks a native whether he is a Christian he will probably reply, "Oh yes, I have been to school." A great number of the rising generation of Kenya Africans have been to school at some time, but mostly only for a year or so, and though they may describe themselves as Christian and educated, they remain in fact essentially unaffected by these influences; a few are highly educated, and by European standards good Christians; and between these extremes are a large number of persons in whom it is impossible to assess the influence of these factors on statistical lines. The problem is still further complicated by the multiplicity of religious denominations, and it is unlikely for instance that the parts played by Roman Catholicism and Seventh Day Adventism would be very similar. It is therefore proposed to ignore the influence of religion and education in this thesis, and in this we are further justified by the fact that the African (like the European child) has a good intuitive perception of the springs of action of other people and is much more likely to be influenced by example than by precept.

There thus remain the factors of working and business relationships with non-Africans—factors which usually involve separation from home and often living in townships, and factors which can be very roughly assessed on the basis of our figures.

Of our 558 admissions, 292 came straight from their homes in the reserves;

173 were working away from home on estates, in townships, or in prison, or were living in a township at the time of certification ; 18 were living as squatters on estates ; and in 75 cases it was not clear where the patients came from at all. As the last 75 cases must fall into the other 3 groups and cannot be ignored, we can only proceed to allot them to the other groups proportionately to the size of the latter. We thus arrive at an approximate figure of 337 admitted from their homes, 200 certified while at work away from their homes or living in townships, and 21 living as squatters.

From a study of the Special Labour Census, 1943, of other Census figures, and of the Annual Report of the Prison Department, and after subtracting the average number employed in the Army, it appears that approximately 300,000 Africans are employed away from home or are living in townships at any one time, approximately 165,000 live as squatters, and approximately 2,940,000 live at home in the reserves.

So that among Africans living at home the certification rate is about 2.3 per 100,000.

Let us next deal with the squatters. These are labourers resident with their families on European estates in their own huts and usually possessed of cattle and goats, who, in return for the right of residence and a monthly wage rather lower than the normal, work for the estate owners for about six months in the year. They usually carry with them the habits and outlook of the tribal area from which they came, family life is not disrupted, the traditional manner of living is not seriously interfered with, and in general the influence of the alien culture on these people is minimal. In regard to the certification rate among squatters we find a figure of 2.5 per 100,000. This figure is of considerable interest. If a squatter becomes insane he is more likely to be certified insane than a native living in the reserve, as he is not likely to be tolerated for long by the European residents on the estate. In other words we have here a section of the population living under fairly primitive conditions, but subject to a degree of contact with Europeans that would be likely to ensure certification if insane. Yet the figure is hardly greater than that for the native reserves. This affords strong corroboration of our previous deduction that the incidence of insanity among Africans in their primitive state is exceedingly low. It even suggests that the incidence is not out of all proportion to the certification rate as described above.

In regard to Africans employed or living away from home, the certification rate is now seen to be 13.3 per 100,000. It is thus considerably higher than that of those living at home. But the yet more striking fact is that the figure still remains quite small compared to British and American figures and, as it is unlikely that employed natives would not be certified if insane, this figure is probably a fairly true measure of the incidence of insanity in these people.

Furthermore, these 300,000 persons living away from home are not a representative cross-section of the population as a whole. They are mostly men, and the great majority lie within the age-group of 15 to 45 years. The rate for this group in America is approximately 95 per 100,000, as opposed to approximately 80 per 100,000 for the population as a whole. So the discrepancy is seen to be even greater.

It was previously demonstrated in Section (c) of this part that there is a marked tribal variability that rides roughshod over the racial incidence, and we are now in a position to explain this phenomenon. The tribes, irrespective of race, that are most detribalized are those with the highest certification rate. Detribalization is difficult of assessment, and other factors besides employment away from home enter into it, but as we are confining our approach to that angle, let us see if the Special Labour Census of 1943 can help us any further. It is there recorded that of the Bantu Kavirondo, Jalu, Kipsigis, Nandi, Kikuyu, Embu and Meru tribes, about 183,000 were employed in 1943. The total population of these peoples is about 2,165,000, so that approximately 1 in 12 of the population were employed. Of all the other Kenya tribes, about 58,000 persons were employed in that year out of a total population of about 1,082,000, so that about 1 in 19 of these peoples were employed. Of non-Kenya natives, nearly 9,000 were employed out of a total population of about 33,000, or about 1 in 4 of the population. The rate of certification among these three groups was 4.0, 1.7, and 16.2 per 100,000 respectively, and it can thus be seen that the question of tribal incidence is closely bound up with the amount of employment, and can be more simply explained in this way than by invoking hereditary and constitutional factors.

The figures of persons living at home and away from home at the time of their certification are shown under each type of insanity (the figures for squatters being included in those for persons living at home as they are now seen to fall for our purposes into that group), but will only be commented upon when they differ significantly from the total ratio.

(e) *The types of mental derangement.*—The admissions have been classified into ten main groups, namely (i) organic psychoses, (ii) epilepsy, (iii) mental defect, (iv) psychopathy, (v) schizophrenia, (vi) paranoia, (vii) manic depressive, (viii) involuntal melancholia, (ix) psychoneuroses, and (x) unclassified psychoses.

This classification permits of comparisons, which are made throughout, with the figures for American Negroes in the State of Massachusetts, and comments are made on the lines laid down in the earlier sections of this part.

Finally, figures of those doing work that could, by European standards, be described as highly responsible are shown separately for reasons that will appear later.

(i) *Organic Psychoses.*

There were 191 cases, or 31.4 per cent. of the total admissions, corresponding to an American Negro figure of 47.0 per cent. 101 were males and 90 were females. The racial figures were Bantus 144, Nilotes 12, Half-Hamites 15, Hamites 5, and Immigrants 15. 95 were known to be living at home at the time, and 65 away from home. Only 3 were known to be doing work that could be described as highly responsible.

The causes were infective-exhaustive (80), senility (45), syphilis (28), encephalitis (10), drugs (7), pellagra (4), brain trauma (3), and unclassified organic (14). They are described in turn, and thereafter organic types that have not been seen are referred to.

(1) *Infective-exhaustive psychoses*.—There were 80 cases, or 13.1 per cent. of the total admissions. The equivalent figure for American Negroes is 4.5 per cent. There were 30 men and 50 women, and their ages varied from 10 to 50 years, with an average of 27 years.

The causes were puerperal (22), malaria (21), acute pulmonary infections (15), phthisis (6), bacillary dysentery (1), typhoid (1), uraemia (1), profound anaemia, probably malarial (3), and various septic conditions (10).

Seventy-three of the cases showed a typically organic type of mental reaction with clouded consciousness, disorientation, inattention, distractibility, incoherence, and sometimes hallucinations; the majority of these were wildly excited and often violent at first, a minority were vague, dazed and muttering. In 7 cases schizophrenic or manic elements were also seen.

Of these cases 10 died, 4 remained at the end of the period, 7 were discharged uncured and 59 recovered—the recovery was usually quite rapid and the average time spent in hospital was 3 months. (This average period refers to the time spent within the 5-year period, so that no account is taken of the time spent in hospital in 1944 by the 4 cases that remained at the end of 1943. This applies to all subsequent average periods mentioned.)

Our high percentage of these psychoses (as compared with American Negroes) is partly due to the high position occupied by malaria as a cause of insanity in Kenya, but appears to be mainly explicable on the following grounds:

In the infective-exhaustive psychoses we see the *one* group of insanities in which (apart from malaria) there is no reason to expect that the incidence should differ very markedly from that obtaining in other parts of the world. So our high proportion is probably due to the relative rarity of various other types of insanity. Indeed if the general incidence of insanity in our Africans is low (as appeared in Section (a) of this part), one could only expect *this* group to show a relatively high incidence.

The large proportion of women is in line with the relative sex incidence for all races in Massachusetts (where the proportion of women is 61 per cent.), and is largely due to the high place occupied by puerperal psychoses.

(2) *Senile psychoses*.—There were 45 cases, or 7.4 per cent. of the total admissions. The equivalent figure for American Negroes is 4.1 per cent. 19 were men and 26 were women, and their ages varied from 55 to 80 years, with an average of 64 years.

Only 7 of these cases were admitted on account of simple senile deterioration, the remaining 38 cases having exhibited delirious episodes in which the predominant symptoms were confusion, restlessness, insomnia, incoherence, irritability, and unconstrained behaviour. They were usually wildly excited, often violent, and persecutory hallucinations and delusions were common.

Of these cases 12 died, 6 remained at the end of the period, and 27 were discharged. Of the 31 non-fatal delirious cases, 15 made an apparently complete and usually rapid recovery, but 16 on recovery revealed a residual dementia. The average period spent in hospital was 6 months.

The delirium was precipitated in at least 20 cases by clear exogenous factors—9 by various real causes of anxiety (fear of bewitchment in 5), 9 by physical illness, and 2 by alcohol.

The large proportion of women is in line with the relative sex incidence for all races in Massachusetts (where the proportion of women is 64 per cent.) and is probably related to a greater longevity in women.

(3) *Syphilitic psychoses*.—The syphilitic psychoses were classifiable into the two categories of cerebral syphilis and general paralysis, and will be described under these headings. The distinction between the conditions was, in this series of cases, a fairly clear one.

(a) *Cerebral syphilis*: There were 11 cases, or 1.8 per cent. of the total admissions; corresponding to an American Negro figure of 2.6 per cent. 8 cases were men and 3 were women, and their ages varied from 19 to 60 years, with an average of 36 years.

These cases showed mental symptoms of organic confusional type in no way different from those described under the infective-exhaustive psychoses. Physical abnormalities included facial and hypoglossal paresis, optic atrophy, tremors of face and hands, dysarthria, dysphagia, convulsions and hemiplegia. The blood Kahn was in all cases positive, and the cerebrospinal fluid in 7 cases examined showed an excess of globulin in 3, an excess of cells in 5, a positive Kahn in 4, and the gold curve was luetic in 4 and paretic in 3.

Of these cases 3 died, 2 remained at the end of the period, and the rest recovered. The average period spent in hospital was 4 months.

(b) *General paralysis*: There were 17 cases, or 2.8 per cent. of the total admissions, corresponding to an American Negro figure of 12.0 per cent. 16 cases were men and 1 was a woman. Their ages varied from 25 to 70 years, with an average of 48 years.

No less than 8 of the 17 cases occurred in immigrant people, in whom it is the commonest type of insanity, forming 27 per cent. of the admissions of these people. So that among admissions of the indigenous population general paralysis only accounts for 1.6 per cent.

These cases were all in an advanced stage of the disease at the time of admission, and were garrulous, inattentive, and usually disorientated in time and place. Their conversation was vague, rambling, often incoherent, and in later stages limited to one word endlessly repeated, or even quite unintelligible. The facial expression was empty and fatigued, and the behaviour apt to be shameless. The mood was euphoric (or even elated) in 13 cases, usually with ridiculously grandiose delusions (e.g. A. M— says he built the whole of Mombasa and owns the whole town; K. K—, on being asked if he has been bewitched says, "He has not, because if any man tried to bewitch him, the man would surely die at once"); anxious, persecuted and somewhat depressed in 3 cases, and apathetic in 1. Constant physical abnormalities were coarse tremors of face, hands and tongue, ataxic gait, slurred and tremulous speech of monotonous tone, and exaggerated tendon reflexes. Argyll Robertson pupils were recorded in 5, but probably occurred in others, as this phenomenon is exceedingly difficult to test in unco-operative African patients with almost black irises. The blood Kahn in all these cases was positive. The cerebrospinal fluid in the cases examined showed an excess of globulin and cells, and a positive Kahn; and the gold curve was paretic in 10 cases and luetic in 2 cases.

Of these cases 15 died, and 2 remained at the end of the period. The

average period spent in hospital, excluding 2 cases that remained for 23 and 58 months respectively, was 4 months.

The very low incidence of general paralysis in the indigenous population is a matter of considerable interest, and will be discussed in Part 7 of this article.

The high proportion showing euphoria and grandiosity is interesting, since in England this "expansive classical form is nowadays rare" according to Curran and Guttmann. Perhaps the most probable explanation is that these "expansive" cases are the most unmanageable, and therefore the most likely to be certified in communities such as ours where many insane are looked after at home.

The relative preponderance of males is noteworthy, but not peculiar to Kenya. In Massachusetts in all races the ratio is 4 men to 1 woman, and Russell Brain (presumably referring to the disease in England) also gives a ratio of 4 to 1.

(4) *Post-encephalitic psychoses*.—There were 10 cases, or 1.6 per cent. of the total admissions. The percentage of admissions of American Negroes for "other brain or nervous diseases," which presumably includes post-encephalitic cases, is 2.2 per cent. There were 9 males and 1 female, whose ages varied from 8 to 40 years, with an average of 25 years.

Physically these cases showed Parkinsonian symptoms with slow, rather rigid movements, mask-like staring expression and monotonous speech; oculogyric crises were observed in 3 cases, slight horizontal nystagmus in 1, and pupillary abnormalities (sluggish and ill-retained reaction to light) in 2, but these reactions are difficult to elicit in unco-operative Africans. Reversed sleep rhythm occurred in 1.

Mentally, the 8 adults were slow, retarded and apathetic, though 2 of these had previously exhibited an acutely excited confusional state; while the 2 children, aged 8 and 13 years respectively, were excessively restless and mischievous.

It is assumed that the cause of these cases was a virus encephalitis, but whether of the lethargica type or some other at present unclassified type is not at all clear. In only two of our series was a clear history of feverish illness at the onset described, and in one other case the syndrome appears to have followed mumps!

Of these cases, 2 died, 2 remained at the end of the period, and 6 were discharged, the average period spent in hospital being 8 months.

(5) *Drug psychoses*.—Two drugs were concerned in the production of insanity in our series of admissions, namely alcohol and Catha.

(I) Alcohol: There were only 4 cases, all men, in whom alcohol had played the sole or preponderant part in the aetiology of the mental derangement. It was thus the cause of only 0.7 per cent. of our admissions, corresponding to an American Negro figure of 10.9 per cent. Their ages ranged from 30 to 60 years, with an average of 36 years.

The cases were all acute confusional reactions from excessive drinking, and all recovered within a few days and were discharged.

It is noteworthy that no cases of delirium tremens were seen in Africans. Among 165 non-African admissions during the 5-year period, 7 cases (or 4.2 per

cent.) were delirium tremens. In fact there is much drinking of native beer with a high alcohol content in the reserves, but the drinking of alcohol in the form of spirits is rare and confined to the townships.

(II) *Catha*: *Catha edulis*, known in East Africa as miraa, is a shrub the stem of which is chewed and the juice swallowed. The chewing of this shrub in moderate quantities is a common custom among certain tribes, notably Somalis, but as a cause of insanity is not referred to in any of the text-books on psychiatry available to me. Three alkaloids have been isolated, of which one (cathine) is identical with one of the most active constituents of the drug ephedrine. In moderate doses it is harmless enough, and appears to act as a true cortical stimulant like caffeine or amphetamine. Some persons, however, acquire a craving for miraa, chew it to excess and to the exclusion of other food, and become sleepless and temporarily insane.

There were 3 cases, or 0.5 per cent. of the total admissions. It is probable that a few other cases (at present recorded as Unclassified) were missed, as we have only lately become aware of *Catha edulis* as a cause of insanity. The equivalent American Negro figure for "other drugs than alcohol" is 0.4 per cent., though the other drugs do not presumably include *Catha edulis*. All our cases were men, and their ages varied from 20 to 30 years with an average of 24 years.

Physically no abnormalities were observed except some corneal injection, slurring of speech, and a slight inco-ordination of the limbs. Mentally, the picture was like that seen in mania, with the addition of schizophrenic elements.

All these cases recovered within, at most, a few weeks and were discharged, but all returned several times within a short period and in the same state—features which suggested addiction to a drug before the precise cause was discovered.

CASE No. 1018.—An immigrant (Tanganyika) man, aged about 30 years, Mohammedan, able to read and write, and working as a hotel boy in Nairobi.

Between 1943 and 1946 he was admitted to hospital eight times for observation. On each admission he was excited, noisy and over-active, and prattled away in a dramatic, elated, disconnected fashion. He laughed easily and at times his gaiety was infectious, but at other times he was merely silly and giggled in an abstracted manner. Physically his speech was slurred, his eyes injected, and his movements slightly ataxic. Recovery was always rapid and apparently complete, and occurred in periods varying from 2 to 4 weeks. This patient persistently denied the taking of drugs at first, but finally admitted to and gave full details of his addiction.

On the occasion of his last admission to hospital he was detained for 9 months, with a view to seeing if the psychosis might recur in the absence of miraa. After his recovery in the first month or two, however, he remained quite sane and sensible until his discharge, and it seems clear that his recurrent attacks of insanity are always precipitated by miraa.

(6) *Pellagra*.—There were 4 cases, or 0.7 per cent. of the total admissions, corresponding to an American Negro figure of 0.2 per cent. There were 3 men and 1 woman, and their ages varied from 17 to 40 years with an average of 24 years.

Three cases exhibited a confusional reaction type with disorientation, restlessness, inattention and excitement; and one case a schizophrenic reaction type with bizarre gesticulations and grimaces. They all showed the character-

istic sharply defined rash on forearms, legs and back of neck, two had chronic diarrhoea, and two had conjunctival ecchymoses (spontaneous in origin) and suggesting a polyavitaminosis. Improvement was very slow and subject to relapses in the non-fatal cases, but in spite of apparent dementia in the intermediate stages, was surprisingly complete in the end.

Of these cases, 2 died and 2 recovered, the average period spent in hospital being 10 months.

(7) *Traumatic psychoses*.—There were 3 cases, or 0.5 per cent. of the total admissions, corresponding to an American Negro figure of 0.5 per cent. They were all men, and their ages varied from 25 to 35 years, with an average of 28 years.

Two cases exhibited the post-traumatic syndrome with irritability and emotional instability, and one case exhibited transitory "epileptoid" episodes characterized by extreme violence and followed by long periods in which he was apparently perfectly normal except for a complete amnesia in regard to the violent episodes.

All these cases apparently made good recoveries, the average period spent in hospital being 5 months.

(8) *Unclassified organic psychoses*.—There were 14 cases, or 2.3 per cent. of the total admissions. There were 6 men and 8 women, and their ages ranged from 20 to 50 years with an average of 35 years.

These cases were all of the organic confusional type as described under infective-exhaustive psychoses and were probably all infective-exhaustive in origin, but the precise cause remained in doubt.

Of these cases 6 died, 1 was discharged uncured, and the rest recovered, the average period spent in hospital being 2 months.

(9) *Organic psychoses not seen*.—No cases of cerebral arteriosclerosis, cerebral tumour, Huntington's chorea, disseminated sclerosis, pernicious anaemia, tabes or Graves' disease were seen in this series.

The first accounts for 9.2 per cent. of American Negro first admissions suffering from mental disorder, the second for 0.2 per cent. of such admissions, the third for 0.2 per cent., and the other four may or may not be included under the figures for "other brain, nervous or somatic diseases."

To the best of my knowledge no case of disseminated sclerosis or pernicious anaemia has ever been described in a Kenya African, tabes and Huntington's chorea have been described but are exceedingly rare, cerebral tumours are rare though we have seen two cases (both tuberculomas) elsewhere, and Graves' disease is uncommon, though perhaps hardly more so than in Europeans. The questions raised by the absence of these diseases, though of much interest, are, however, rather outside the scope of this thesis. There remains arteriosclerosis, which may show mental factors in its aetiology, and in which there is a dramatic discrepancy between our figure of *nil* and the American Negro figure of 9.2 per cent.

Arteriosclerosis is rare in Kenya Africans. Among 662,846 patients treated throughout the Colony in 1943, only 2 cases were diagnosed as arteriosclerosis. Among 1,000 consecutive post-mortem examinations performed by F. W. Vint on native bodies in Nairobi, no case of generalized arteriosclerosis was described.

Donnison, working in South Kavirondo (Kenya), examined over 15,000 natives and, although searching for cases of cardio-vascular disease, on which subject he was writing a thesis, stated that "on no occasion was a diagnosis of arteriosclerosis made." Yet the incidence of cerebral arteriosclerosis among Negro first admissions with mental disorder in America is 9.2 per cent., and among whites in the same series is 11.5 per cent. The rarity of arteriosclerosis in Kenya Africans will be discussed in Part 7.

The small proportion of organic psychoses as a whole (31.4 per cent.) as compared to the American Negro proportion (47.0 per cent.) is accounted for by the absence of cerebral arteriosclerosis, and the rarity of general paralysis and alcoholic psychoses.

(ii) *Epilepsy.*

There were 21 cases or 3.4 per cent. of the total admissions, corresponding to an American Negro figure of 3.1 per cent. There were 20 men and 1 woman, and their ages varied from 5 to 30 years, with an average of 23 years. The racial figures were Bantus 19, Nilotes 1, and Half-Hamites 1. 17 were known to be living at home and 3 away from home, and none was doing responsible work.

These cases were all "idiopathic" epilepsy, and the diagnosis was only made after excluding other causes of convulsions. Moreover I am informed by F. W. Vint, the Senior Pathologist, that in over 4,000 autopsies he has not seen a case of cerebral cysticercosis, which is not surprising in view of the apparent absence of *Taenia solium*.

Twenty of the patients had typical major epileptic fits varying in number from 1 to 40 a month, and 1 had psychomotor equivalents in which the face was screwed up and the patient ran a short distance with a staggering gait, and was apt to fall over obstacles and hurt himself severely. *Petit mal* was also seen. 15 were admitted on account of excited and violent behaviour, and of these, 9 showed a rapidly increasing dementia, 4 were sullen, resistive, truculent, egotistical and suspicious in the interparoxysmal periods, and 2 were apparently normal between the fits. 5 were admitted on account of extreme dementia, and 1 was congenitally imbecilic. The symptoms and course were in fact quite similar to those seen in other parts of the world.

Of these cases 11 died, 3 remained at the end of the period, and 7 were discharged, the average period spent in hospital being 12 months.

Epilepsy is common among Kenya Africans, and cases are not sent to Mathari unless violent or very demented. This explains the rapid deterioration and high mortality seen in our cases.

The low relative incidence in women is partly accounted for in the same way, and partly in that epilepsy in general appears to be relatively uncommon in Kenya women. Among 120 African epileptics seen throughout the Colony as out-patients in 1943, 98 were men and 22 were women.

(iii) *Mental Defect.*

There were 65 cases, or 10.7 per cent. of the total admissions, corresponding to an American Negro figure of 3.8 per cent. 44 were men and 21 were women,

and their ages varied from 16 to 55 years, with an average of 30 years. The racial figures were Bantus 51, Nilotes 8, Half-Hamites 4, Hamites 1, and immigrants 1. 41 were known to be living at home, and 16 away from home, and none was doing responsible work.

Only feeble-minded persons suffering from other mental disorder are included in our series, for comparative purposes. In fact 34 cases were admitted on account of a super-imposed psychosis (usually schizophrenic but often atypical), and 31 cases on account of episodes of violent and emotionally uncontrolled behaviour quite similar to those seen in the psychopathic class to be described below. Recovery from the mental disorder was usually rapid, but recurrences were the rule in the psychopathic group, and the schizophrenic patients were very apt to relapse if discharged. The distinction between these two groups was often difficult and rather arbitrary. The diagnosis of mental deficiency was made partly on the history, partly on personal impressions and partly on intelligence tests.

Of these cases, 6 died, 28 remained at the end of the period, and 31 were discharged, the average period spent in hospital being 13 months.

The relatively large percentage of mental defectives with mental disorder in Kenya is probably accounted for by the fact that no institution (other than Mathari) exists in Kenya for mental defectives, so it is assumed that a great number of such persons remain at large and are easily precipitated into insanity by the various hazards of life outside an institution.

No deductions in regard to the incidence of mental defect in the general population can be made from our figures, and in any case African figures based on European definitions of mental deficiency would not be strictly comparable with European figures for this condition. An African who for instance "required care, supervision and control for his own protection" in the simple and rather routine life of a native reserve would be a very *low grade* feeble-minded person indeed.

Though rather outside the terms of reference of this thesis it is of interest to record that imbeciles and idiots have been seen, that cases of congenital syphilis with imbecility, microcephaly with characteristic sugar loaf skull, cretinism, and congenital diplegia have been seen, though rarely, but that no cases of mongolism, epiloia or cerebro-macular degeneration have to the best of my knowledge ever been described in a Kenya African.

(iv) *Psychopathic Personality.*

There were 17 cases, or 2.8 per cent. of the total admissions, corresponding to an American Negro figure of 0.9 per cent. 12 were men and 5 were women, and their ages ranged from 16 to 50 years, with an average of 31 years. The racial figures were Bantus 8, Nilotes 2, Half-Hamites 4, Hamites 2, and immigrants 1. Six were known to be living at home and 10 away from home, and 1 was doing responsible work.

Sixteen of these cases fell clearly into the class that has been entitled "predominantly aggressive psychopaths," and exhibited episodes when they were aggressive, truculent, violent, excited, emotional, unmanageable and

often shameless. In the intervening periods they were apparently normal except for their lack of regret and foresight, and a tendency to go for what they wanted at all costs and without regard to consequences. The violent episodes were often precipitated by alcohol, physical illness or some slight environmental frustration, and were usually transitory.

One case, a male, aged 18 years, was a "predominantly inadequate psychopath" who had been arrested for representing himself as a policeman. No very clear reason appeared for his doing so, and his action was probably an attempt to compensate for feelings of inadequacy. He was a happy-go-lucky person and very lacking in foresight, and even indulged in petty theft while in Mathari in circumstances in which he was bound to be discovered.

None of these cases was feeble-minded by intelligence tests and of them all 1 died, 4 remained at the end of the period, and 12 were discharged, the average period spent in hospital being 6 months.

No points of peculiar interest appear to arise in regard to this psychopathic group, and the relatively high percentage of aggressive psychopaths compared to the American figures is presumably due to the fact that in a community such as ours, where many amenable insane are looked after at home, these are just the sort of unmanageable cases that are most likely to be certified.

The large proportion living away from home has no bearing on the aetiology of the condition. It is accounted for by the fact that 7 of the men were certified while serving a prison sentence, and 2 of the women were prostitutes in townships. So that the fact that they were not committed from their homes was a symptom of the condition rather than a cause.

(v) *Schizophrenia.*

There were 174 cases, or 28.6 per cent. of the total admissions, corresponding to an American Negro figure of 27.3 per cent. 129 were men and 45 were women, and their ages ranged from 14 to 50 years with an average of 28 years. The racial figures were Bantus 122, Nilotes 27, Half-Hamites 17, Hamites 5, and immigrants 3. 91 were known to be living at home and 63 away from home, and 8 were doing responsible work.

These patients were mostly classifiable into the four types commonly described, though a few could only be described as mixed types of schizophrenia. The symptoms as seen in the different types were as described below.

(1) *Simple type.*—There were 23 cases, 17 men and 6 women. The chief symptom in these was a marked apathy, with inattention, lack of interest in the environment and self-absorption. They were usually slow, vague, silly, evasive, suspicious and muttering, and sometimes showed evidence of emotional dissociation and apparently causeless giggling or weeping. Their manner was often odd and affected, and slight echolalia was not uncommon. Some cases showed symptoms described under the hebephrenic type, but in a mild form; indeed the distinction between these two types was often rather arbitrary.

Of 17 known cases, 9 (or 53 per cent.) were certified away from home, and 8 at home.

(2) *Hebephrenic type*.—There were 87 cases, 67 men and 20 women. These patients were usually admitted on account of noisy, aggressive, abusive, destructive and violent behaviour. When first seen at hospital they remained in this state, or exhibited bizarre grimaces, attitudes, gesticulations and general behaviour, bizarre thought content (e.g. A. K— was told by God he would see more light if he drank his own urine) and emotional dissociation and uncontrol. They were resistive, inconsequent, nonsensical, shameless and dirty, and often exhibited verbigeration and ill-systematized delusions, usually of a religious and exalted type (e.g. N. C— said that God would burn the District Commissioner's office, and she would command the soldiers by wireless to burn his books), and showed evidence of hallucinations, especially auditory. When the florid symptoms passed there was often some residual mental deterioration. Of 77 known cases, 27 (or 35 per cent.) were certified away from home, and 50 at home.

(3) *Katatonic type*.—There were 32 cases, 21 men and 11 women. These patients showed periods of muteness, apathy, curious statuesque attitudes, catatonia, stereotypy, negativism or sometimes *flexibilitas cerea*. At other times (often before admission) they were noisy, incoherent, turbulent, dirty, unconstrained, abusive, violent and probably hallucinated. Delusions when observed were usually persecutory (e.g. O. K— made a murderous attack on a complete stranger and said, "You have bewitched my head and made me mad"), but sometimes grandiose (e.g. M. A— believed he had a right to anything he wanted, and threatened to assault a man who would not give up the shoes he was wearing).

Of 30 known cases, 16 (or 53 per cent.) were certified away from home and 14 at home.

(4) *Paranoid type*.—There were 11 cases, 8 men and 3 women. The symptoms on the whole were of the hebephrenic type but with a tendency to chronic grievances and delusions, the delusions being ill-systematized and often bizarre, usually persecutory but sometimes grandiose (e.g. G. K— hears his wife, who is actually 100 miles away, continually abusing him by wireless; M. K— is really a European, and the reason for his black skin is that his European parents lost him as a baby so he was turned into a Jaluo; J. D— had been called to preach to everyone to fight for freedom, and believed that the possession of an Altar Cross which he stole from a Mission Church was necessary for his purpose; M. C— has enormous wealth and is Jesus Christ and awaits his army who are following behind). These patients were apt to be suspicious, irritable, and at times aggressive and quarrelsome (e.g. one patient who believed he was God made a savage attack on another who also said he was God, as there is only one God).

The whole syndrome was intermediate between schizophrenia and paranoia and the average age of these patients was 5 years greater than that of the other 3 types, but it should be mentioned that the title "*paraphrenia*" has not been used in this article so that some of the cases included in this section might be called *paraphrenics* by another observer.

Of 9 known cases, 4 (or 44 per cent.) were certified away from home, and 5 at home.

(5) *Mixed types*.—There were 21 cases; 16 men and 5 women. These were all typical schizophrenics, but not definitely classifiable into one of the above types.

* * *

Of all these cases 31 died, 54 remained at the end of the period, 89 were discharged, and of those discharged 59 had apparently made a good recovery or remission. As, however, is the case elsewhere, schizophrenia is *the* chronic form of insanity and the average period spent in hospital was 13 months.

A feeble-minded element was probable in the aetiology of at least 13 cases, and an organic in 10. Most of the others, however, were definitely *not* feeble-minded and some were clever.

In regard to the detribalization figures (i.e. 63 out of 154 cases of known origin, or 41 per cent.), it will be noted that they are almost exactly the same as those for insanity as a whole, which is 42 per cent. But we have drawn attention (in section (a) of this part) to the fact that insane persons are looked after by their relations for an average period of 6½ months, and as schizophrenia is *the* chronic type of insanity, so the figure of schizophrenics admitted from the native reserves is likely to be much nearer the true figure for this disease than is the figure for infective-exhaustive and other short term types of insanity. The proportional incidence of schizophrenic psychoses in persons living away from home is accordingly likely to be much higher than in other insanities as a whole.

There is of course nothing very remarkable about this. It merely serves to support the theory that certain types of personality in a certain age-group tend to respond to environmental difficulties with a schizophrenic syndrome, and to indicate that the African mind is not immune from this type of pathological response. That the problems are real enough will appear from Part 6, and it is merely surprising that schizophrenia is not even commoner.

In regard to the several types of schizophrenia, the large proportion of simple types certified away from home (53 per cent.) merely suggests that such cases, if living in the reserve, are apt to be looked after at home or possibly not even recognized as insane. The small figure for hebephrenics certified away from home (35 per cent.) and the large for katatonics (53 per cent.) and paranoids (44 per cent.) suggests that constitutional factors may play a larger part in the former and environmental factors in the latter (especially katonics), though other explanations are possible. But the total numbers concerned are too small and the differences too slight to warrant any profound analysis of their separate causes. Moreover in our experience the distinctions between the various types are often rather arbitrary, and Curran and Guttmann's observation that these types are not separate entities, and that "when a case is observed for a sufficient length of time combinations and permutations can usually be observed," is as true for Africans as for Europeans.

(vi) *Paranoia*.

There were 11 cases, or 1.8 per cent. of the total admissions, corresponding to an American Negro figure of 3.2 per cent. 10 cases were men and 1 was a woman, and their ages varied from 35 to 60 years, with an average of 48 years.

The racial figures were Bantus 3, Nilotes 2, Hamites 4, and immigrants 2. At the time of their certification 4 were known to be living at home and 6 away from home, and 5 were doing responsible work.

These patients exhibited well-systematized delusions of a persecutory type, and were otherwise normal except for a general tendency to petty grievances, suspicions and litigiousness, and occasional aggressive outbursts due to the persecutory ideas. An element of superiority in manner and attitude occurred in all, but definite grandiose delusions were only seen in 3. None of these patients were hallucinated, and all were of comparatively high intelligence. As examples of the delusions, H. H— is in very close touch with God and Jesus Christ, and has a mission to perform by telling all the people to go to church and school; B. B— was convicted of manslaughter, and subsequently developed a fixed delusion that the trial judge had actually allotted him £2,200 and two forests, and continually pestered the authorities about this.

Of these cases 5 remained at the end of the period and 6 were discharged, the average period spent in hospital being 15 months. Complete recovery was never seen.

Three points arise for comment :

Of the 11 cases, no less than 9 had for long been living in an alien or inimical environment—4 as travelling traders, 2 as prisoners, 1 as an itinerant preacher, 1 as a farm overseer, and 1 as an internee.

The large proportion of Hamites (36 per cent.) is also noteworthy. Hamites form only 3·6 per cent. of all our admissions, and 18 per cent. of all our Hamitic admissions are paranoiacs. It was at first thought that there must be a racial tendency to paranoia. Indeed this possibility cannot be excluded, but on closer scrutiny of all the case histories it seems that the manner of life of our Somali paranoiacs (cattle driving and trading over vast distances through alien tribes) is sufficient to account for the high incidence of this disease in them, without invoking racial factors.

The large proportion of men finally calls for comment. In America there are more than twice as many women as men. But the manner of life again accounts for this; it is rare for women to live in the types of environment above described.

(vii) *Manic-Depressive Psychoses.*

There were 23 cases, or 3·8 per cent. of the total admissions, corresponding to an American Negro figure of 8·3 per cent. The racial figures were Bantus 22 and Nilotes 1. 9 were known to be living at home and 11 away from home, and 8 were known to be doing responsible work. The cases fell into two classes, acute mania (19) and chronic mania (4) and no cases of depression were seen.

(1) *Acute mania.*—Of the 19 cases, 18 were men and 1 was a woman. Their ages ranged from 18 to 45 years, with an average of 30 years.

These patients were excited, elated and garrulous, and showed a press of psychomotor activity and a flight of ideas which were usually grandiose. Grandiose delusions when seen were more in the nature of gross exaggerations of fact than definite delusions (e.g. M. M— says he is “immensely strong and

broke 6 pairs of handcuffs in 6 days"—he did in fact break one pair before admission to Mathari). They were apt at times to be irritable, quarrelsome, aggressive and occasionally dangerously violent.

Of these cases, 2 remained at the end of the period, and 17 were discharged, of whom 15 had apparently made a good recovery, the average period spent in hospital being 4 months.

These 19 cases were all first admissions to Mathari, as only first admissions are described in this thesis, but it is noteworthy that 3 of them returned within the 5-year period with a similar attack, that 5 others gave a history of a previous attack not in Mathari, and that 10 other admissions with acute mania (not included in our figures) were not first admissions. So that the condition is very apt to be a recurrent one.

In no case was a previous history of depression obtained, however, and none showed depressive symptoms on recovery from the mania.

Among the 19 cases, organic precipitating factors were observed in 10. None of them, however, was feeble-minded, and most were highly intelligent. At least 8 of these cases were doing responsible work at the time of their certification—3 running their own business (as butchers or timber merchants), 2 working as clerks, 1 as a school-teacher, 1 as a hospital assistant, and 1 as a European's cook.

(2) *Chronic mania*.—There were 4 cases, 3 men and 1 woman, and their ages ranged from 50 to 65 years with an average of 60 years.

The symptoms were precisely as described under acute mania, but the course was very chronic, and with the passage of time a certain stereotypy of thought and behaviour was seen.

Of these cases 1 died, 2 remained at the end of the period, and 1 was discharged, the average period spent in hospital being 14 months.

Only one of these cases had had a previous attack of acute mania to my knowledge, and none any previous depression.

(3) *Depression*.—No case of depression, other than the involutional melancholics described in the next section, has been diagnosed at Mathari. Nor have any of the manias given a previous history of depression, but it must be admitted that this statement is of little value as African histories are very unreliable. Moreover H. L. Gordon, working at the same hospital and describing 120 consecutive male admissions in 1935, saw no cases of depression.

Yet among 165 non-African admissions during the 5-year period 9 were suffering from acute depression (with depression, difficulty in thinking, psychomotor retardation, and usually ideas of guilt). Moreover among the 14 acute manias seen in the same series, at least 6 had had previous depression; and at least 5 of the 9 acute depressions had had similar previous attacks elsewhere.

From the figures of American Negro insane available to me no clue appears in regard to the relative proportion of manias and depressions, but it seems fairly safe to assume that it is not strikingly different from the proportions obtaining in other parts of the world or the matter would have been commented upon.

In regard to the manic-depressive psychoses in general, the low percentage of 3·8 per cent. can probably be explained as a result of the absence of depression.

The very small proportion of women is noteworthy; in America for all races there are nearly 3 women to 2 men, but here again we do not know what is the sex ratio for manias alone. The large proportion of men can, at least in part, however, be accounted for by the fact that so large a proportion of our cases were certified away from home (when the ratio of males is always high).

The large proportion of persons certified away from home (55 per cent.) is noteworthy, but the really striking fact (with which it is linked) is that at least 42 per cent. of the acute manias were doing responsible work. In regard to all other types of insanity the equivalent figure is 3·6 per cent.

Finally, the absence of depression is remarkable, and one is forced to wonder if cases do occur but fail to reach the mental hospital. It is theoretically possible that they might not be recognized as insane, or that they might commit suicide or recover before certification.

In regard to the first possibility however, one can see no good reason for such cases being more likely to remain at home than, say, simple schizophrenias or involuntional melancholias, of whom not a few have been admitted.

In regard to the last two possibilities also, suicide fails to prevent the admission of involuntional melancholias, and is perhaps less likely than in that condition to account for an absence of cases. It must be recorded, however, that the suicide of Africans is not unknown, and not confined to the involuntional period of life. Moreover attempted suicide was occasionally seen in prisoners during the 5-year period, but in none of the cases so seen did the depression last long enough nor was it severe enough for the subject to be certified as insane. As will be seen in Part 6, the African in general is highly "cyclothymic" in the sense that he exhibits well-marked though transitory mood swings which are usually clearly related to environmental factors. It seems not unlikely, therefore, that our lack of cases in this category is related to an absence of *sustained* depression of psychotic type—a point which is referred to again in the conclusion.

(viii) *Involuntional Melancholia.*

There were 8 somewhat atypical cases, or 1·3 per cent. of the total admissions, corresponding to an American Negro figure for "involuntional psychosis" of 0·4 per cent. 4 were men and 4 were women, and their ages ranged from 40 to 65 with an average of 51 years. The racial figures were Bantus 6, Nilotes 1, and Half-Hamites 1. 5 were known to be living at home and 2 away from home, and none was doing responsible work.

These cases occurred at the climacteric period of life, and the patients were depressed and anxious, vaguely persecutory and hypochondriacal, and sometimes agitated or suicidal. The mood change appeared to be primary and the persecutory ideas secondary. In no cases were psychomotor retardation or ideas of sin or unworthiness seen. In none of these was a previous history of mental disorder found, and the cases clearly fell into a separate group from the

manic-depressive psychosis proper—an observation that supports the views of Henderson and Gillespie on this subject.

Of these cases 2 died, 1 remained at the end of the period, and 5 were discharged, the average period spent in hospital being 5 months.

The only feature that appears to call for further comment and will be discussed in Part 7 is the consistent absence of ideas of guilt from the picture.

(ix) *Psychoneuroses.*

There were 24 cases, or 3·9 per cent. of the total admissions, corresponding to an American Negro figure of 1·8 per cent. 22 were men and 2 were women, and their ages ranged from 20 to 55 years with an average of 32 years. The racial figures were Bantus 15, Nilotes 4, Hamites 1, and immigrants 4. Four were known to be living at home and 15 away from home, and none was doing responsible work.

All the cases except one recovered within 3 months, mostly within a week, and the average period spent in hospital was 2 months.

These cases fell into two main types, namely hysteria, and one which we can only designate as “frenzied anxiety.” These two types are described below and thereafter the psychoneurotic absentees are briefly referred to.

(i) *Hysteria*.—There were 3 cases, all men, 1 fugue, 1 deafness, and 1 aphonia. It is doubtful whether these cases should be included in this article, so they will not be further discussed. The hysterical syndromes that occur in Africans are similar to those seen in Europeans, but naturally only certain types such as those above mentioned are likely to find their way into a mental hospital.

(ii) *Frenzied anxiety*.—There were 21 cases, 19 men and 2 women. In this condition the onset is associated with some real source of anxiety (perhaps only real to an African), but the anxiety is not sustained, and is soon replaced by a state of frenzy in which the patient is excited, noisy, incoherent, and perhaps filthy, aggressive, and dangerously violent. The violence often results in homicide but is apt to be ill-directed and generalized, and the supposed author of the patient's anxiety may or may not be among the victims. Recovery usually occurs within a few hours or days and is as complete as it is rapid, but 4 of these cases on recovering from the frenzy developed hysterical symptoms—2 deaf-mutism, 1 deafness and 1 aphonia. The subject subsequently always denies all memory for the period of the frenzy. The precipitating cause is usually clear, and most of the patients on recovery are themselves cognizant of at least some of the factors that produced their mental breakdown. How far the condition is deliberately self-induced in some cases is a moot point, but once induced it becomes a very real type of insanity—the patient is temporarily quite without insight or self-control, and may commit irreparable damage to his own interests and violence quite unrelated to the precipitating cause. Thus one patient had been physically ill, believed himself bewitched by a neighbour, and developed a hysterical frenzy in which he killed his wife and child.

The chief precipitating causes were as follows : in 8 cases an urgent wish to

leave work and return to the reserve was thwarted, in 3 cases the onset of unaccountable illness induced a fear of bewitchment, and in 4 cases the patient's wealth or ill-treatment of his wife also resulted in fear of bewitchment (for reasons which will become clearer in Part 6). The causes tend, however, to overlap, temporary physical illness often plays a part, and the patient usually believes he has been bewitched by a particular person (often the object of his own guilty feelings, though hardly recognized as such), and will die.

A closely similar, if not identical, condition is described by Fletcher under the title of "amok" occurring in Malays, but perhaps it is common to various primitive peoples, and it is doubtless much commoner in Kenya than our figures would indicate, as the great majority recover too quickly to be certified insane.

As the condition appears not to have been described before in East Africa and may not be identical with "amok," it behoves us to discuss its differential diagnosis from other conditions.

There is a certain resemblance to the temporary paranoid states that sometimes complicate physical illness, in that physical illness does often precede the onset of the mental disturbance. But the relation of the physical illness to the mental is quite different in the two cases, for whereas in these paranoid states the mental faculties are directly affected by the illness so that the patient's critical faculties and judgment are impaired, in the case of "frenzied anxiety" the patient's judgment in the early stages is only too clear according to his lights and he sees his illness as definite threat to his life.

The distinction from the violent episodes that occur in aggressive psychopaths is perhaps rather unreal, in that the episodes themselves may be identical. In practice, however, it is found that such an episode is apt to occur as an isolated event in the life of an African, is precipitated by some very real source of anxiety, and does not (as it does in Europeans) imply the possession of a certain markedly egotistical type of personality. One might of course argue that *all* primitive Africans are psychopathic, in that their personalities are by European standards immature. Part 6 of this article shows that this is substantially true, and we believe that in certain circumstances this reaction may be exhibited by *any* such African.

CASE No. 1005.—A Mkamba (Bantu) man, aged about 30 years, living at home in the reserve, pagan, married, with one wife and three children—all sons, and the youngest aged about 7 years.

On 10.1.44 he was tried for the murder of his wife and youngest son on 28.12.43. At the trial it transpired that he was apparently normal until 4 p.m. on 27 December, when he "started behaving in a very odd manner, plucking grass and putting it in the fire, picking up stones and putting them on the cooking pot and throwing water about." The next morning he got up, collected his bow and arrows and a hammer, and chased his wife and other relations out of the house and down a hill towards a river. The relations managed to cross the river and escape, but the wife—running behind them and carrying her son—was too late, and the accused caught up with her and battered both her and his little son most brutally to death with the hammer. All the witnesses were agreed that he had never been insane before, was on good terms with his wife, and never took alcohol. His father, who saw him just after his arrest a few hours later, said he "looked mad" at that time.

In answer to questions by the accused at his trial, his sister-in-law said, "Yes,

you told me that you thought you were going to die and instructed me to call the elders, so that if you did die your wife would be well cared for—you told me to tell your father and brothers to look after the children—you then told me to go away but to come back later to see if you had died." It is not made clear in the evidence when he made these remarks, but it is fairly certain they were made on the evening of the 27th, as the sister-in-law was in the house at that time.

At this point the accused was remanded for 10 days for observation of his mental state and, the trial being resumed on 19.i.44, the doctor gave evidence that he had found no signs of mental or physical disease.

The accused elected to make a statement which ran as follows: "I would not have killed my wife and child had I not been ill; if I had not killed my wife I would have died. All my troubles have come from an old man called 'X' with whom I had a quarrel. There was another man who wished to marry my sister and he brought beer to my father as a preliminary to the marriage. 'X' wished to drink this beer but I refused to allow this as my father was away at the time. 'X' then said, 'You may drink the beer to-day but this will be the last time.' He meant that he would bewitch me and cause my death. I had only one wife and by her death I have now no wife and no one to look after my children." X's threat appears to have been made a week or two before the crime, and two days before the crime some charms were found at the entrance to accused's home and were assumed to have been placed there by X.

The accused was found guilty but insane at the time of the act, and was admitted to Mathari on 4.ii.44.

On examination he was found to be of good physique, no physical abnormalities were observed and his blood was negative to malaria and to the Kahn test. Mentally he was found of good intelligence and in no way insane, though naturally somewhat depressed at what had happened. He adhered to his story as given in court, but admitted to no recollection of his behaviour on the morning of the 28th, though he had heard about it later.

His condition up to the time of writing (12.ii.47), remains quite unchanged, and in fact quite normal except for the amnesia for the time of the crime.

His manner is at all times mild and amenable, and he shows none of the truculence and resentment so characteristic of aggressive psychopaths, nor has he exhibited any aggressive outbursts, although frustrations must have been frequent during this period.

Like the other cases that fall into this category he arrived at Mathari long after he had recovered his mental equilibrium, but the history is sufficiently complete to support the diagnosis of frenzied anxiety. An interesting point that emerges in this case is his remark, "If I had not killed my wife I would have died." It appears most probable from the evidence that he would have killed anyone he caught up with, and that the fact that he killed his wife was merely due to her being the last to reach the river.

It was suggested in Part 7, Section (h) of this article that a primitive person whose life is in jeopardy believes that *any* death will appease the gods, and we believe that the accused in this case really meant, "If I had not killed *someone* I would have died," but the failure to generalize is characteristic.

(iii) *Psychoneurotic absentees*.—No cases of obsessive-compulsive neurosis or anxiety neurosis in the European sense have been seen at Mathari.

They would of course be unlikely to be sent to a mental hospital, but it is of interest to record that, with the single exception of "cardiac neuroses" which are not uncommon in Africans, these syndromes appear to be rare—an observation that is based on one's general medical experience throughout the Colony. Among non-Africans, on the contrary, anxiety neuroses of all types are among the commonest of medical conditions seen.

It seems likely therefore that the condition we have labelled "frenzied anxiety" tends to replace in Africans many of the types of anxiety neurosis,

and perhaps some of the depressions, that are seen in Europeans. This problem and the absence of obsessional neuroses are discussed in Part 7.

* * *

In regard to the statistics of psychoneuroses as a whole the only points that appear to require further comment are the large proportion of persons certified away from home and the high ratio of men. Frenzied anxiety, however, by the brevity of its course, is *par excellence* the type of insanity that is unlikely to find its way from the reserves to the mental hospital unless crime results. This explains both these points, and the condition is doubtless really quite common in the reserves.

(x) *Unclassified Psychoses.*

There were 75 cases, or 12.3 per cent. of the total admissions, corresponding to an American Negro figure of 4.7 per cent. 55 were men and 20 were women, and their ages varied from 15 to 60 years with an average of 34 years. The racial figures were Bantus 54, Nilotes 9, Half-Hamites 4, Hamites 4, and immigrants 4. 38 were known to be living at home and 33 away from home, and 5 were doing responsible work.

Twenty of these cases had recovered their sanity before they were examined, 11 cases died shortly after admission and before a certain diagnosis could be made, 11 cases could only be described as terminal dementias (probably initially feeble-minded), and the remaining 33 cases were undiagnosable mainly because of the absence of histories or difficulties in interpretation of the numerous tribal languages—factors which account for the high proportion of unclassified cases in general.

Of these cases, 19 died, 10 remained at the end of the period, and 46 were discharged, the average period spent in hospital being 6 months.

* * *

In view of the absence of true psychotic depression from our series, it is important to record that in 10 cases in the unclassified group the prevailing mood was depressive. But two of these were almost certainly katatonic stupors (sitting in a mummy position and remaining mute or monosyllabic until their deaths 10 and 24 months after admission), and the other 8 showed symptoms or signs suggestive of organic disease and were probably secondary to physical illness of various types. None of these cases, in short, fell clearly into the above-mentioned category.

* * *

The method of comparing proportional rates, used throughout this part, is convenient when considering figures of a grossly different order of magnitude, but is sometimes fallacious.

The following table is therefore appended and shows the absolute annual figures, the proportionate rates and the absolute rates, and the final column shows the ratio obtained by dividing the Kenya rates into the American rates. The figures for Kenya Africans shown in this table refer to non-military cases, for reasons explained in the introduction.

	Kenya Africans.			American Negroes.			Ratios.
	Admissions per annum.	Admission proportion. per annum.	Rate per 100,000 per annum.	Admissions per annum.	Admission proportion. per annum.	Rate per 100,000 per annum.	
Organic psychoses . . .	36.2	32.4%	1.12	36.6	47.0%	75.5	67
Epilepsy . . .	4.0	3.6%	0.12	2.4	3.1%	4.9	41
Mental defect . . .	13.0	11.6%	0.40	2.9	3.8%	6.0	15
Psychopathy . . .	3.4	3.0%	0.10	0.7	0.9%	1.4	14
Schizophrenia . . .	32.0	28.7%	0.99	21.4	27.3%	44.1	45
Paranoia . . .	2.2	2.0%	0.07	2.5	3.2%	5.2	74
Manic-depressive . . .	4.2	3.8%	0.13	6.5	8.3%	13.4	103
Involuntional melancholia . .	1.6	1.4%	0.05	0.3	0.4%	0.6	12
Psychoneuroses . . .	2.4	2.1%	0.07	1.4	1.8%	2.9	41
Unclassified psychoses . . .	12.6	11.3%	0.39	3.6	4.7%	7.4	19
	111.6	99.9%	3.44	78.3	100.5%	161.4	47

5. A TABULATION OF THE MORE STRIKING PECULIARITIES OF MENTAL DERANGEMENT AS COMPARED WITH SUCH DERANGEMENT IN EUROPEANS AND AMERICAN NEGROES.

The facts have now been described, and from these facts the following appear to emerge as the most significant peculiarities :

(a) The incidence of insanity among Africans living in their natural environment is probably very low.

(b) The incidence of insanity among Africans working away from home is probably considerably higher than that of those living at home, but is still low.

(c) General paralysis is rare in the indigenous population.

(d) Arteriosclerosis is rare.

(e) The relation of paranoia to certain modes of living.

(f) The relation of mania to responsibility and the absence of depression (manic-depressive type).

(g) The absence of ideas of guilt in involuntional melancholia.

(h) The common occurrence of "frenzied anxiety" and the apparent absence of most of the types of anxiety state seen in Europeans.

(i) The absence of obsessional neuroses.

* * *

Most of these peculiarities can be discussed in relation to the African's attitude to life, arising out of his peculiar culture and thinking, so that Part 6 will consist of a description of these. The description refers particularly to the agricultural peoples (who form the great bulk of the population), but is also true with slight modifications of the pagan pastoral peoples. It does *not* refer to hunters and food gatherers, of whom we have no experience in Kenya, and whose attitude may well be a very different one.

6. NATIVE CULTURE, THINKING AND ATTITUDE TO LIFE.

The peculiarities of the primitive African's attitude to life would appear to be conditioned by three factors: (a) his inherent mode of thought, (b) his relation to his natural environment, and (c) his relation to his social environment. These three factors are almost inextricably mingled in his attitude but, for the sake of clarity, we have tried to describe it in relation to these factors.

As far as practicable, and with a view to minimizing personal bias, this part takes the form of direct quotation from several other writers.

(a) *His inherent mode of "thought."*—The peculiarities of primitive African thinking can for the most part be well explained on the assumption that "phantastic" thinking plays a larger part in it than "directed" thinking. "Phantastic" thinking, as defined by Jung, is characteristic of day-dreams, dreams and myths, is especially marked in children and primitive peoples and is essentially an immature mode of thought. In contradistinction to "directed" thinking it is undirected, or more correctly is directed by the passing emotions and not by conscious effort. It is accordingly automatic and spontaneous, effortless and untiring, wish-fulfilling and dependent on unconscious and semi-conscious impulses, unproductive and uncritical, and leads from reality to phantasy and thinking in images and feelings rather than in words.

Largely in accordance with this and to quote Westermann, "With the Negro emotional, momentary, and explosive thinking predominates . . . dependence on excitement, on external influences and stimuli, is a characteristic sign of primitive mentality. Primitive man's energy is unstable and spasmodic. He is easily fired with enthusiasm for an undertaking and begins his work with great zest; but his interest dies down quickly and the work is abandoned. . . . Where the stimulus of emotion is lacking, the Negro shows little spontaneity and is passive. He waits for what is coming to him and evades what is inconvenient, or adapts himself to it, instead of bravely confronting the obstacles of life and mastering them. . . . The Negro has but few gifts for work which aims at a distant goal and requires tenacity, independence, and foresight." He lives in fact more vividly in the passing moment than does the European, and it is for example common for an African in receipt of good monthly wages to be penniless and starving for a few days before his next pay-day.

In regard to the outer world, and in Westermann's words—"The interest which the African takes in things is not an academic one. They concern him in so far as they are useful to him or can do him harm . . . observation is often superficial; conclusions have been drawn from it in a most uncritical way; and instead of further thought on the matter, word-spinning has seemed sufficient. The African has never progressed so far as the knowledge of true causal connections or natural laws. He possesses a certain amount of knowledge of nature, . . . but for the greater part it is pseudo-science-knowledge mixed with a child-like play of imagination. . . . His meditation . . . easily assumed the character of an interesting and amusing entertainment." The ability of the African to lie convincingly is notorious, and one is constrained to believe at times that the story-teller has also temporarily convinced himself.

As a result perhaps of his immature and egocentric imagination speculation about nature is essentially anthropomorphic, and in Westermann's words, "The idea of an event happening from an inner natural necessity is difficult for him to grasp. . . . Behind an occurrence there is for him not so much a cause as one who causes. If a tree or a human being dies, then someone, be it a spirit or a person or a 'power,' has made him die. For inner necessity or natural causes a 'personal' will is substituted." In accordance with this

and with his ill-developed powers of self-criticism the African usually attributes his misfortunes to the anger of some external agency and rarely blames himself.

In general, as Westermann says, "The world of the primitive African is characterized by its unity and coherence. No sharply defined aspect exists by itself; wish and reality, the possible and the impossible, knowledge and belief, thought and imagination, the realms of secular and religious life are interwoven and fundamentally one." Dreams and conscious experiences might well be included—a homesick labourer is apt to dream that his father is ill and calling for him, and to attach as much significance to this "message" as if it came by post.

(b) *His relation to his natural environment.*—The primitive African is very close to nature and the realities of life and death. Disease and misfortune are familiar experiences, they come apparently causelessly like bolts from the blue, and the workings of fate are so inscrutable that he is apt to feel like a feather blown by the wind. He feels an especial fear and suspicion of anything striking and unusual, and a great consciousness of ignorance and awe of the unknown.

As will be seen in Section (c) of this part, each man is heir to the whole knowledge of his group, with the obvious corollary that he is well aware of the limitations of that knowledge. The individual European by contrast is usually profoundly ignorant of the limits of human knowledge and so has largely lost this feeling of awe of the unknown.

This feeling, which may well be described as "religious," plays a large part in primitive life, and in Driberg's words—"Every activity has its religious background and sanction, and it would be quite impossible to divorce their religious beliefs from their everyday practices without completely destroying the basis of their society." Thus, to quote Kenyatta, "At the birth, initiation, marriage and death of every Kikuyu, communication is established on his behalf with God. . . . When people meet to discuss public affairs or decide a case, or at public dances, they offer prayers for protection and guidance."

Moreover he hates admitting to any sort of success (e.g. number of children alive); he is so used to misfortune that success itself is strange, and likely to be snatched away by the jealous gods.

(c) *His relation to his social environment.*—Most primitive people including East Africans have developed a large, complicated and rigid social organization (based on a wide extension of the family system), by which a high degree of security for the individual is achieved in face of the manifold hazards of nature; there is a place for everyone within this system, and widows and orphans for example are never outcast or destitute.

This organization implies and demands the observance of meticulous rules and restraints in regard to manners and behaviour in all departments and at each stage of life, and in Kenyatta's words, "In all tribal education the emphasis lies on a particular act of behaviour in a concrete situation." Thus the manner of address and behaviour of a Kikuyu would be different in the presence of his father's sister from that in the presence of his mother's sister, and would be subject to still further rules according to whether he were circumcised or not. These rules, though unwritten, are so well known that any infringe-

ment implies an unsocial motive. In Driberg's words, primitive peoples "draw much more precise conclusions from acts or words of discourtesy. Not only is resentment felt, but it is also assumed—and generally rightly—that there was a deliberate intention to offend. . . . When all are disciplined to a certain uniformity of behaviour, any aberration is apt to be looked upon as a manifestation of witchcraft." Moreover the rules only apply within the group and tribe; outside these limits there are no rules for there is no general abstract code.

Everyone sooner or later knows the whole culture of the group; there is little specialization and a great equality of knowledge. Status depends on age rather than on intellect, knowledge or achievement (indeed outstanding achievement is apt to be deeply suspect), and, as actual ages are unknown, on certain landmarks, especially puberty and marriage. Occupations and rules of conduct are strictly arranged according to these landmarks, and the African constantly acquires more rights and duties in an ever-widening field, as the social organism of which he is an essential part increases in size with each rise in status. Thus O. F. Raum, referring to the Chaga—a Bantu tribe of Tanganyika—says, "The majority of children have conduct patterned for them by their sex and their membership in a clan and age-group . . . in those social situations which matter conduct is prescribed and enforced, as well as facilitated, . . . age, sex and clanship assert their influence throughout life . . . primitive life simply places individuals in definite relationship to one another, prescribing how each is to behave, and reserving for each his share of rights and duties."

The primitive African's sex-life is similarly governed by meticulous and explicit rules and taboos, which correspond to his age status and permit of sexual outlets related to his developing physical needs. Thus, according to Kenyatta and referring to the Kikuyu, "before initiation it is considered right and proper for boys to practise masturbation," but "it is considered an indecency to be seen doing it, except by boys of the same age-grade." After initiation "the boys and girls are told that . . . they must acquire the technique of practising a certain restricted form of intercourse," and "anyone seen masturbating after initiation would be looked upon as clinging to a babyish habit and be laughed at, because owing to the free sex-play which is permitted among young people, there is now no need to indulge in it." In regard to marriage, "a man may have as many wives as he can support—the custom also provides that all women must be under the protection of men—and that all women must be married in their 'teens,' so that spinsters and prostitutes are unknown, and indeed no words having these meanings exist in the language. Instruction in general is clear and shameless and, though specific restraints are imposed, there is no shameful mystery about sex or need for repression.

All primitive peoples (including East Africans) are closely attached to particular areas of land; all customs, culture, religion and myths refer to particular localities which are the visible symbols of clan kinship and nurse the ancestral spirits. Thus, for the Kikuyu, the ancestral spirits reside at the tops of certain fig trees, and God resides on Mt. Kenya. The primitive cannot visualize annihilation, and the African believes his spirit survives and acquires

(by a natural age-group progression) still greater status and power after death, and is finally reincarnated in the family. Indeed, as Driberg has pointed out, the most potent factor in the authority of primitive law is the moral support it draws from the will of the dead ancestors. So the land is held in trust by the individual for the family (past, present and future), and landless people do not occur.

In regard to religion the primitive, as was mentioned in Section (b) of this Part, feels a great awe in face of the unknown and recognizes higher powers—higher than the ancestral spirits—who must at times be supplicated. There is however, little link between ethics, and religion and in Westermann's words, "The gods and ancestors take but a slight interest in the ethical behaviour of their worshippers and are almost indifferent as to the inner attitude in which they are approached. What they demand is offerings and invocations. . . . Ethics, in the sense of civic virtues, are rooted in the traditional rules regulating the behaviour in social groups." Both ethics and religion apply moreover only within the group, and the gods can only be supplicated by the group, not by a lone individual. There is thus no conception of universal truth or justice, or of right or wrong in any general sense, and in Raum's words, "The child becomes conditioned to a morality whose demands become less stringent the remoter they are from the 'initial situation' of the family."

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We have now described, as shortly as possible, the factors that appear to condition the primitive African's attitude to life, and it remains to describe the attitude that results.

Again we cannot do better than quote Westermann, who says: "The consciousness of being an organic and well-protected member of a group gives the individual a definite self-consciousness and dignity . . . he is not easily embarrassed. Within his own circle he is never in a position where he does not know how to behave or what to do . . . work is not specialized in the same way as with us and therefore the non-expert 'layman' . . . does not exist. The African is able to enlarge with ease on any subject; . . . he does not suffer from social disabilities, for there is hardly any economic dependence, nor is there a distinction between servant and master, rich and poor. Hence nobody suffers from an inferiority complex. . . . It is natural for him to express his real personality, for everybody knows everybody else, and no one can therefore permanently conceal his nature." In spite of age statuses the prevailing feeling is one of equality—each man after all will be of high status one day if he lives long enough. His attitude to sex is equally self-assured and healthy.

This is the bright side of the picture, and the contrast with the European, who is apt to be trammelled by social castes and economic disabilities and to suffer from a sense of social or sexual inferiority, and who often tries to act a part, needs no stressing.

The African feels, however, that what strength and stability he has comes from the fact that he is part of a larger organism, and that he can only preserve this modicum of power by playing most meticulously his special part in this

organism. In fact he enjoys observing the rules, as they give him a feeling of correctness and security, and he does not like thinking for himself.

This attitude governs his whole life, and results in extreme conformity to tradition, conservatism in thought and fear of innovation—there is no room for free thought or for misfits, and even secretive, solitary or outstandingly successful people are suspect. In Westermann's words, a "man does not plan his life, set himself an aim and exercise his strength in attaining it. The individual as such has no aim in life if his task is to become exactly like the rest. . . . The motives for his actions are predominantly social, not individual, and are deeply influenced by public opinion. . . . Personal responsibility is avoided wherever possible." In the absence of any general conception of the inherent nature of cause and effect, he regards the workings of fate as arbitrary and haphazard and, provided he has obeyed the traditional rules, he rarely blames himself for his failures and misfortunes, but is apt to believe himself bewitched. Since his codes of behaviour only apply within his group and in relation to his clan land, and since he has no general abstract code, alien codes are apt to leave him cold or utterly perplexed and he feels quite lost and rudderless in a foreign land.

The European by contrast is free to travel or live alone, he has general rules only, and he feels that his strength and stability derive from himself alone; but he is apt to feel more isolated and conscience-stricken, often does not know what to do in a given situation and has to think it out for himself.

Finally, in contrast to his social and sexual self-confidence, the primitive is profoundly conscious of the limits of his knowledge of nature and of his power to control his natural environment. An attitude of humbleness and awe results from this, and an implicit faith in higher powers who manifestly set little store by him as an individual, but are interested in and can be approached by his social group. If this is religion, then religion is far more real to the primitive than to the modern European.

7. AN ATTEMPT TO EXPLAIN THE PECULIARITIES OF MENTAL DERANGEMENT LISTED IN PART 5.

We are now in a position to study the peculiarities of mental derangement in our Africans and attempt to explain them. Each peculiarity, as tabulated in Part 5, will be discussed in turn. It must be reiterated that the word "primitive," wherever used in this part, refers to the pagan agricultural and pastoral peoples of Kenya, and that hunters and food gatherers have not been seen.

(a) *The incidence of insanity among Africans living in their natural environment is probably very low.*

This can be partly explained by the rarity or absence of certain specific types of insanity (namely cerebral arteriosclerosis, general paralysis and alcoholic psychoses, which in the aggregate account for 32 per cent. of Negro first admissions in America). Other likely factors are a high general mortality, resulting in wide differences in age composition of the population, and a high

mortality among the insane. These explanations alone seem inadequate, however, to account for our findings, as was deduced in Part 4.

* * *

In the aetiology of mental derangement, hereditary and environmental factors play varying parts according to the type of insanity, so that at one end of the scale we see a psychosis due to brain injury in which the environmental factor may approximate to 100 per cent., and at the other end a psychosis associated with Huntington's chorea in which this factor may be almost non-existent.

Recent research has tended to emphasize the part played by hereditary and constitutional factors in the various types of mental disease but, except in certain rarer types not seen in our series, they have not been credited with exclusive causation. In the great bulk of insanities a place remains for environmental factors—sometimes large as in the infective-exhaustive psychoses, sometimes apparently small as in the schizophrenias and manic-depressive psychoses. Indeed Slater says that the environment and the genotypic milieu probably play an important but non-specific part in *all* the hereditary mental disorders. So long, however, as a place is left for environmental factors, be it ever so small, this place is important, and in certain circumstances might become transcendently so.

To be more precise, Rosanoff found 68 per cent. concordance for schizophrenia in uniovular twins. These twins were presumably on the whole living in roughly similar types of environment. Had one of each twin been translated at birth and for life to some hypothetically easy environment, it is safe to assume that the concordance would have been very much less. If both twins had been so translated it is safe to assume that the concordance would have been roughly the same, but the general incidence much less.

Now the primitive African *may* be less heavily loaded with deleterious genes than the European. The presumption would be so, since natural selection might be expected to eliminate the genes concerned more rapidly in a primitive community. Against this, however, we have the evidence of the American Negro figures. These figures are even greater than those for American whites, and show the same types of insanity in roughly similar proportions. Admittedly American Negroes derive from West Africa but, according to Oliver, mainly from Bantu stock, and there is no reason to believe that the genetic constitution of West African natives is grossly different from East African.

However this may be, it does not seem necessary to invoke genetic factors, as our problem can surely be answered without reference to these. Environmental factors alone could supply the answer.

It is clear from the assemblage of facts in Parts 3 and 6 that the primitive African lives in a difficult natural environment, but that his social environment is made very easy for him, for rules of procedure govern his every act and he seldom has to think for himself, and that his sex life is similarly governed by rules related to his developing needs. Moreover economic problems (such as may arise from droughts, epidemic disease, etc.) are shared with the community and rarely borne in isolation.

In so far as mental derangement is due to problems arising in the social, sexual and economic spheres, it is quite difficult to see how such derangement can occur among primitive people. Indeed a relatively large proportion of our psychoses occurred on a basis of mental deficiency.

We deduce, therefore, that the rarity of insanity in primitive life is due to the absence of problems in the social, sexual and economic spheres, and that its frequency in Europe and America is due to the multiplicity of such problems. This deduction in regard to economic problems is well supported by Dayton's observation that "from 1923 to 1929 the increasing admission rates for mental disorders show a remarkable year to year agreement with the decreasing numbers employed."

(b) *The incidence of insanity among Africans working away from home is probably considerably higher than that of those living at home, but is still low.*

We have explained in Part 6 how an African's life is governed by rules of procedure, and that these rules apply only within his social group and in relation to his own country. Prior to the advent of the European this system was all-sufficient and adequate to his needs. No African at that time would have dreamt of travelling by himself outside his tribal boundary—such behaviour would indeed have been quite efficiently suicidal. European settlement has altered this, and large numbers of Africans are constrained (by the poll tax system) to go forth each year and work on estates and in townships, etc., where their own rules of behaviour no longer apply.

If insanity is ever precipitated by an inability to adapt oneself to environmental problems and frustrations, it is small wonder that its incidence in these people is relatively high.

The fact that the incidence is still low in terms of European figures is again not surprising. The great bulk of employed Africans are not away from home very long—a fact which affects our problem in two ways. Firstly, many of these people are essentially untouched by the alien culture and by no means detribalized; they regard the period as a tragic or comic interlude with no other relevance to their lives than the need to earn the poll tax, and they return to their homes and their tribal customs without any permanent scars or conflicts. Secondly, an unknown but doubtless considerable number break down *after* their return home and appear in our figures as certified in the reserves, although in many cases their insanity was probably precipitated by partial detribalization.

(c) *General paralysis is rare in the indigenous population.*

This raises two points of interest.

Craig and Beaton in the 4th edition of their *Psychological Medicine* (1926) say, "Within the last few years investigators have injected patients with the benign tertian parasite of malaria, basing their action on the apparent immunity to general paralysis of natives in the tropics who have had malaria." Russell Brain in the 2nd edition of his *Diseases of the Nervous System* (1940) says, "In many tropical and subtropical countries where syphilis is rife general

paralysis is almost unknown among the natives." Yet in Uganda (where malaria is endemic and syphilis is rife) Trowell found that 33 per cent. of the persons he certified as insane were suffering from neurosyphilis, and one infers from his description that the great majority of these were general paralytics. The very low rate among the indigenous population of Kenya affords, it is thought, strong support for the statement made in Part 3 that syphilis is a recent introduction to this colony. Far from there being any immunity to general paralysis among "natives in the tropics who have had malaria," they appear to be unduly susceptible to it, as evidenced by the Uganda figures and by our figure (of 27 per cent.) among immigrants. Moreover, there is certainly no racial immunity to this disease in Negroes, as shown by the American figures. No doubt Kenya will reap the whirlwind in 10 or 20 years' time.

The second point is the relation of yaws and syphilis to general paralysis. Manson-Bahr in *Manson's Tropical Diseases*, 11th edition (1941), says, "Harper in Fiji believes that late manifestations of yaws occur as in syphilis, and that they produce neurological conditions resembling those of locomotor ataxia and general paralysis." Shelley and Watson, in *An Investigation concerning Mental Disorder in the Nyasaland Native*, say, "We are . . . tempted to assume that yaws does affect the central nervous system." Yet yaws is endemic in Kenya and until a few years ago was ubiquitous. If yaws were liable to result in general paralysis one would expect to see more cases of the latter. An investigation of the nature of this thesis cannot prove that general paralysis never results from yaws, but it is felt that our figures strongly support this contention, and that general paralysis results solely from syphilis.

(d) *Arteriosclerosis is rare.*

The relation of arteriosclerosis to hyperpiesis and of both to more remote causes remains obscure. It is clear that, while the two conditions are often associated, yet each may run its course independently. It is likely that certain types of arteriosclerosis often result from hyperpiesis, but unlikely that hyperpiesis results from arteriosclerosis.

The facts in regard to the Kenya African are that generalized arteriosclerosis is rare as shown in Part 4, and that hyperpiesis is very uncommon. Donnison, who examined over 15,000 persons in South Kavirondo especially in regard to cardio-vascular disease, found "it was very uncommon . . . to meet with a systolic blood pressure that persisted for long above 144 mm." Furthermore, in an examination of 1,000 healthy male natives aged from 15 to about 75 years, he found the average systolic pressure reached a maximum of 126 mm. in the age group 25 to 35 years, and then steadily fell to below 106 mm. in the age group 60 years and over. Moreover Muwazi and Trowell, in a study of neurological disease among Uganda natives based on 14 years' experience of clinical work in East Africa, say, "We doubt if we have ever seen a case of essential hypertension, unaccompanied by renal disease, in an African, apart from a slight rise in a few elderly people."

The rarity of arteriosclerosis and of hyperpiesis in our Africans suggests that, in so far as these conditions are not causally related to each other (presumably by arteriosclerosis resulting from hyperpiesis), they are both related to

some common cause. Moreover, this cause, which might be hereditary or environmental (or more likely a mixture of both), is lacking in Kenya Africans.

The importance of hereditary factors has been stressed by various writers, but that they do not play an exclusive role is strongly suggested by a comparison of the African and American Negro figures for cerebral arteriosclerosis. For whereas in the former this condition was not seen, in the latter it is actually commoner than in American whites.

It is not within the scope of this article to discuss all the environmental factors that have at various times been postulated as causative of these conditions. The importance of "psychical" factors has, however, been stressed by many writers, and cannot be ignored.

Thus Halls Dally says, "In many persons psychical factors play a leading part in inducing transient or even sustained rises in blood-pressure, but whether these are primary or whether they merely activate an inherent constitutional disposition is still uncertain." Lakin says, "Modern urban life with its constant rush and incessant strain, with its leisure too often spent without relaxation, is highly favourable to the development of arteriosclerosis." Halls Dally quotes Moschcowitz as saying that most hyperpiesics conform to a certain type, which he thus describes: "Psychically they are the opposite of the child. They do not play. They have no illusions. They are tense and irritable with 'single-track' minds. While their mental horizon is narrow, within this range they are terribly concentrated, and pursue their aims with grim desperation. . . . Most have lived what may be called a 'hard' life. The struggle for existence has begun early, and their life represents little else than a desperate battle. They have no time for play. Here again the child that is in all of us goes early, and once gone rarely heeds the summons to return." Other recent writers have demonstrated a correlation between hyperpiesis and "chronic hostility."

If psychical influences and attitudes such as those described really play any significant part in the causation of these conditions (and are not merely symptoms of the physical disease), then the latter's absence in our Africans is well explained. A reference to Part 6 of this article shows that the qualities and the attitude described by Moschcowitz for instance are precisely the opposite of those of the African, who seldom "pursues an aim with grim desperation" for more than a few moments. The "long-continued anxiety states" elsewhere described as causative by Halls Dally are hardly seen, and "chronic hostility" is quite foreign to the African attitude. Donnison, writing in 1929 and referring to the theory that hyperpiesis results from a "high pressure existence" or mental stress, said, "I think almost everybody who has been closely associated with the African native will agree that he very rarely can be described as living a high pressure existence."

Approaching the subject as we do from a purely negative angle, we cannot suggest which particular element in the mental attitude of Western civilization is responsible for the high incidence of hyperpiesis and arteriosclerosis; but it is submitted that the rarity of these conditions in our Africans is entirely consistent with the primary importance of a mental attitude in their causation, at least in many cases.

This inevitably leads us to a further point. It is customary to assume that the psychosis occurring in association with cerebral arteriosclerosis are due to the latter. Perhaps it may be truer to say that these psychoses are often simply a senile deterioration in persons with a certain "arteriosclerotic" type of mental attitude, and that both the psychoses and the arterial change develop out of this.

(e) *The relation of paranoia to certain modes of living.*

Out of a total of 11 cases of true paranoia, no less than 9 appeared to be clearly related in their aetiology to environmental factors in the social sphere, namely prolonged sojourn in an alien or inimical environment.

Constitutional factors are sometimes held to play the preponderant role in the aetiology of paranoia, so that the importance of exogenous factors in African cases seems to be worth commenting upon.

The African's codes of behaviour are quite inelastic and have no application in an alien environment, as we have shown in Part 6. Moreover a stranger has little chance of being accepted as one of themselves by the group into which he migrates, and he is indeed often justified in acquiring persecutory ideas. It is not surprising therefore that such people are apt to develop paranoia.

No doubt constitutional factors play their part—not all cattle-drivers or long-term prisoners develop paranoia—but it would seem that such factors are rarely sufficient by themselves to precipitate this illness. Long-standing exogenous factors are also required in the case of the African.

We have remarked in Part 4 that environmental factors appear to play a larger part in the production of paranoid than in that of hebephrenic schizophrenia. If schizophrenia exhibits itself as a *series* of syndromes—hebephrenia, paranoid schizophrenia, and paranoia—with increasing preservation of the personality, then this finding in regard to paranoia is not surprising.

(f) *The relation of mania to responsibility and the absence of depression (manic-depressive type).*

The syndromes classified together under the title "Manic-Depressive Psychoses" may in particular individuals (in Europeans) manifest themselves as recurrent or isolated attacks of depression or mania, or manic-depressive cycles.

Henderson and Gillespie discuss the aetiology of the manic-depressive psychosis as though all these varieties were manifestations of one disease. Curran and Guttmann, more warily, say, "Manic and depressive psychoses are grouped together because (1) they may alternate in the same case; (2) some of the striking symptoms may be regarded as exact opposites." The twin research figures available to me show a 70 per cent. concordance for manic-depressive insanity in monozygotes and a 16 per cent. concordance in dizygotes, but do not discriminate in regard to different varieties of this psychosis.

Our experience in Africans, in whom mania was seen but not depression, suggests one of two possibilities: (1) that the genetic inheritance of different

types may be independent, or (2) that the genetic inheritance may be the same in all, but the African's environment may in some way prevent its manifestation as depression. These two possibilities will be discussed in turn.

(1) Our first possibility implies that types of the manic-depressive psychosis in which depression is manifested have a distinct genetic inheritance from types in which depression plays no part, and that the former is genetically absent in our Africans. In this case, no further comment on our relatively small figure (3.8 per cent) for the psychosis as a whole would be required.

It is easy to imagine that, if the inheritance of the two types were distinct, the depressive types would never establish themselves in a primitive community, as affected stocks would quickly die out. A depressive patient would be likely to die or commit suicide in his first attack, and seldom live to propagate in his first remission.

It seems unlikely, however, that this explanation is correct, as the distinct nature of the inheritance would presumably have been noted elsewhere. Moreover, depression presumably occurs in American negroes (or its absence would have been remarked upon), and we can only assume that their genetic inheritance is not grossly different from that of our Africans.

(2) Our second possibility implies that mania and depression are manifestations of one disease, but that environmental factors play a larger part in the symptomatology of this disease than has been recognized. In this case, our small figure for the psychosis as a whole requires further comment.

In regard to the psychopathology of mania, Henderson and Gillespie say that "from some very strong wish that has been repressed into unconsciousness, the repression is at least partly removed, and the patient feels and behaves as if the wish had been fulfilled"; in regard to that of depression they say, "the precipitant is the reanimation . . . of an unconscious wish which if allowed to reach consciousness, would ultimately destroy the personality. Hence a gigantic effort is made at repression, and the inhibition becomes generalized, so that all thinking is interfered with." The fact that this psychosis in our Africans always takes the form of mania might therefore be due to the fact that the repressing and inhibiting elements of his mind have so far been less exercised and are weaker than these elements in the European, and that in any conflict between the repressed and the repressing elements the former are accordingly more likely to triumph at the present stage of his development.

If for this or some other cultural reason, the manic-depressive psychosis always takes the form of mania in our Africans, it remains to discuss the relative rarity of the psychosis as a whole.

Now the striking point about our cases (of acute mania) is that a large proportion (at least 42 per cent.) were holding responsible positions, and apparently possessed an attitude of personal responsibility quite foreign to the normal African attitude. For all other types of insanity combined, the equivalent figure is 3.6 per cent. One is led to wonder, therefore, whether the occurrence of this psychosis is not bound up in some way with the possession of a certain attitude to life.

In any race it would seem that the attitude of the manic is, "I am a wonder-

fully successful and important person and my success is entirely due to myself," while that of the depressive is, "I am a miserable failure, and this is entirely my own fault." The two conditions have this in common—a strong sense of personal responsibility. It is customary to assume that the attitudes expressed by manic-depressives are secondary to and rationalizations of the mood change. Our observation does seem, however, to raise the possibility that the attitude may play a larger part in the aetiology of this disease than is usually recognized. The hereditary factor in the manic-depressive psychosis is now known to be large, but we submit that it is unlikely to manifest itself except in the presence of an attitude of individual self-sufficiency.

Perhaps the most striking difference between the European and African cultures is that the former demands self-reliance, personal responsibility, and initiative, whereas there is no place in the latter for such an attitude, as we have seen in Part 6. There seems, moreover, no need to assume that the difference in attitude is intrinsically racial—the individualistic attitude can seldom develop in primitive society, but must thrive in communities such as those of Western Europe, whose watchword (in recent generations and apart from Sundays) has been, "Each man for himself and the devil take the hindmost." On this theory, the fact that the incidence of the manic-depressive psychosis in American negroes is no lower than that in American whites is well explained.

If this theory is correct one would expect to find among Europeans a higher incidence of this psychosis in the higher social strata; in fact Landis and Page found it accounted for 16.7 per cent. of first admissions to private hospitals and for only 12.9 per cent. of first admissions to state hospitals, and Dayton found it ranked fourth among the types of insanity in persons of comfortable economic status as compared to seventeenth in persons dependent on aid from public funds. One would expect a higher incidence in teetotallers than in drunkards: Dayton found it ranked fifth among the types of insanity in the former as compared to nineteenth in the latter. One would expect to find a low incidence in a period of war (when the State tends to shoulder the individuals' responsibilities) and a high incidence in periods of decreasing employment or economic depression: Dayton's figures of the incidence of this psychosis for the years 1917 to 1933 fulfil this expectation. Perhaps above all one would expect to find a higher rate among Protestants than among Catholics (since in theory at least responsibility is personal in the former and largely shared with the Church in the latter): Dayton, among persons over the age of 12 years, found a rate of 533 per 100,000 Protestants and of 277 per 100,000 Catholics.

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If the occurrence of the manic-depressive psychosis is partly dependent on an attitude to life as here suggested, then a resemblance to the schizophrenic psychoses appears, for it has long been held by one school of thought (following Meyer) that schizophrenia is dependent on certain attitudes to life, albeit very different ones from that which may operate in the manic-depressive psychosis.

We are therefore led to wonder if the defunct theory of polymorphism might not be resuscitated in a limited form as applicable to these two psychoses. Henderson and Gillespie say, "There is an impression that the children of

manic-depressives show an abnormal liability to schizophrenia," and if this impression proves correct, it might perhaps be most simply explained on a polymorphist theory. The rather common occurrence of either psychosis showing features characteristic of the other, and even of frankly undiagnosable mixtures of both, might also be best explained in this way.

(g) *The absence of ideas of guilt in involutinal melancholia.*

Our involutinal melancholics fitted quite well into the picture of this condition as seen in Europeans, except that ideas of unworthiness or guilt were replaced by persecutory ideas.

There seems little doubt that the mood change in this condition is primary (being related to endocrine disturbance), and that the delusions are in the nature of secondary rationalizations. As we have seen in Part 6, ideas of guilt are quite foreign to the primitive African, and persecutory ideas are predictable as his rationalization of such a mood change as depression.

That cultural influences may determine the type of rationalization has been demonstrated by Seligman, who noted that delusions of a religious nature with a sense of guilt were practically absent in Japan, where religion is cheerful and assumed primitive virtue rather than original sin.

Our observation supports this finding, and seems to require no further comment.

(h) *The common occurrence of "frenzied anxiety" and the apparent absence of most of the types of anxiety state seen in Europeans.*

In regard to the aetiology of anxiety states, Henderson and Gillespié say that "their origin may be found in all the types of conflict of individual needs with reality. . . . Clinical observation shows clearly that when anxiety arises from any conflict it diffuses itself generally throughout the mind, that if this conflict is not squarely faced, in the course of its diffusion the anxiety becomes concentrated again in a manner determined by the individual's mental history to some special topic in itself apparently of indifferent emotional value, and that a state of morbid anxiety results."

It would seem that at the point where the anxiety "diffuses itself generally throughout the mind" the primitive can sustain his anxiety no longer. His emotions in general are ill sustained, as we saw in Part 6, he feels that something must be done, his aggressive impulses are allowed full play, and he runs amok with indiscriminate violence. His ill-developed powers of self-criticism with a constant tendency to look outside himself for the causes of misfortune are the main factors in the onset of this reaction type.

A further factor is believed to play a part, and helps to explain why the impulse to action so often takes the form of homicide.

In many cases, such as those in which the patient is physically ill or believes himself bewitched, the anxiety is really a fear of death. Now according to Porteus it is one of the characteristic patterns of Bantu belief that all life is related in a mysterious way, and that there is only a certain amount of life force ready for disposal. This belief affects Bantu custom in many ways,

e.g. a mother must not become pregnant again till the last child is weaned, new life must not come into contact with new life elsewhere, twins are unfortunate, a pregnant woman must not visit a sick person, and so on.

We question whether this belief is confined to the Bantu. Opportunities for unlimited increase of human life must everywhere (especially in primitive life) be few and far between, and usually achieved at the expense of human life elsewhere; and this experience would be readily translated by primitive people into a belief in a limited amount of life force.

It is therefore suggested that, when a Bantu (and probably any other race that exhibits this syndrome) kills in a state of frenzied anxiety, he believes in his heart of hearts that *any* death will appease the gods, and that his own life can only be saved in this way. In Case 1005 this point is well illustrated.

Biologically, the physical concomitants of fear (or anxiety) prepare the body for fight or flight, but in our civilization the impulse to action is suppressed, with results which, though advantageous for society, are often disastrous for the individual.

(i) *The absence of obsessional neuroses.*

Primitive culture is essentially obsessive—compulsive. Behaviour is normally governed by a host of precise rules and, if misfortune occurs, further complicated procedures must be followed.

In Western society the individual must often develop his own standards of conduct. But such standards are never so satisfactory as those sanctified by tradition, for the individual cannot forget that he has as much right to modify them as he had to develop them in the first instance. Indeed many people attempt to fill the void by subjecting themselves to various bizarre or even whimsical disciplines.

The aetiology of the obsessional neurosis is not, according to Henderson and Gillespie, the same in all cases, but it would seem that it is only when the individual stands alone and must develop his own ethical code that this neurosis can develop.

8. CONCLUSION.

Judging from the American negro figures and from our own observations, we find (rather surprisingly) that the African's inherited tendencies to mental disease are probably not very different from the Europeans.

The African, in common with other primitive agricultural and pastoral peoples, has however evolved a social system that has probably remained substantially unaltered for many thousands of years. This system, though completely obstructive to any type of change or progress, must be well suited to man's mental needs, and rarely permits of situations that might cause mental breakdown (except of the transitory type that we have designated frenzied anxiety).

The essential feature of this system is that the individual, in his social

behaviour patterns, *is never introduced to abstract concepts*, but obeys meticulous rules in a host of concrete situations. Internal consistency is not developed or required, and phantastic thinking prevails.

Civilization of the modern European type, with its insistence on individual self-sufficiency, derives from the ancient Hellenic culture. In its modern expression, however, it dates from the Protestant and the later Industrial Revolution, and is only a few hundred years old.

Its essential feature is the constant necessity for personal choice and personal decision—the *constant application of general codes to particular situations*. Its implications are manifold. It implies an attitude of responsibility for the past, and of concern for the future. It implies the emergence of a dominant “self-regarding sentiment,” to which the expression of conflicting urges must be reconciled. It implies the *generalization* of inhibition, for whereas the African attitude is “one *may* do anything not specifically prohibited by society,” the European attitude is “one *may not* do anything unless specifically permitted by oneself.” It implies the development of endogenously conditioned and *sustained* moods, as opposed to environmentally determined and transitory emotions. Finally, directed thinking is required and a higher minimum level of intelligence.

These developments, implicit in a change from social to personal control, must seriously disturb an equilibrium that had until recently been stabilized for so long. They appear to account for the occurrence of certain types of mental disturbance in particular, and its high incidence in general in Western Europe and America to-day.

The habit of directed thinking and all that this implies in the way of intellectual self-confidence and fearlessness has doubtless come to stay. If evolutionary progress, as Huxley says, has always followed the lines of increased control over and independence of the environment, then directed thinking fulfils these requirements and is a valuable human asset.

But this advance need not imply *complete* self-sufficiency, and a personal responsibility that embraces *all* aspects of life. The need for co-operation is not thereby diminished but, with the growth of recorded knowledge, is increased. Nor is such an attitude adequate to man's sense of values.

Society is not absolved by this advance from *its* responsibilities to the individual, and we are led to surmise that the next steps in human progress must include a release of directed thinking into more totally satisfying and ultimately useful channels by a partial return to primitive ways in the shape of some form of social protection and control.

SUMMARY.

The scope of the present article is to describe the nature and extent of mental derangement as it occurs in African natives of Kenya; to compare the picture with the very different one which occurs in North American negroes and in Europeans; to explain the differences observed by reference to environmental factors; and to discuss the significance of our findings in regard to the aetiology of mental derangement in general.

The clinical material consists of 609 patients admitted to Mathari Mental Hospital during the 5-year period 1 January, 1939, to 31 December, 1943.

The article falls into eight parts :

First : A short summary of the historical background, to demonstrate that, until quite recently, the natives of the interior were untouched by alien influences.

Second : A short summary of the racial and anthropological background. Kenya lies on a highway of Hamitic infiltration into Negro Africa, and every type from pure Negro to pure Hamite can to-day be seen. The five main racial and cultural groups are described.

Third : A short summary of the public health background. This is a description of the main public health problems in Kenya in so far as they differ from those found in Great Britain.

Fourth : A study of the facts of mental derangement as seen in admissions of new cases to the Mathari Mental Hospital. The facts are studied under five headings: (a) total incidence, (b) sex incidence, (c) racial incidence, (d) incidence in relation to detribalization, and (e) the types of mental derangement.

Fifth : Based on the studies undertaken in Part 4, the more striking peculiarities of mental derangement as compared with Europeans and American negroes are here tabulated.

Sixth : A description of African culture, thinking and attitude to life.

Seventh : An attempt to explain the peculiarities of mental derangement in the African listed in Part 5, largely with reference to the attitudes described in Part 6.

Eighth : This part attempts to review the picture as a whole, and to relate its essentials to a background of social and mental evolution in a frame of time—past, present and future.

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A CLINICAL AND PSYCHOLOGICAL STUDY OF ECHO-REACTIONS.

By E. STENGEL, M.D.Vienna, L.R.C.P.Edin.

From the Department of Clinical Research, Crichton Royal, Dumfries.

THE automatic repetition of words heard (echolalia) and actions seen (echopraxia) has long been known to occur in certain psychotic states in cases of aphasia and in low-grade mental deficiency. Echographia was established as a sub-type of echopraxia (Pick, 1924). The similarity of the pathological echo-reactions with phenomena occurring normally in childhood during the early period of speech development was pointed out by Wyllie (1894) and Pick (1902), who studied them in aphasia. The most recent study dealing with echo-reactions is that of D. E. Schneider (1938), who described the syndrome echolalia, echopraxia, grasping and sucking. Most previous writers investigated echo-reactions either from the neurological or psychiatric point of view and not enough attention has been paid to the comparative aspect and to the question of a common underlying mechanism. In this study an attempt has been made to investigate that problem.

Echo-reactions have been observed chiefly in the following conditions: (1) Aphasia of the "transcortical" type and advanced dementia resulting in a similar speech disorder. (2) Low-grade mental deficiency with incomplete development of speech. (3) Chronic epilepsy. (4) States of clouded consciousness of various origins. (5) Catatonic states. (6) Early period of speech development in childhood. (7) States of fatigue and lack of attention in the normal.

Echo-reactions in Aphasia.

In certain cases of aphasia (transcortical aphasia of the classical scheme) echolalia is a marked feature. Although the anatomical and physiological concepts underlying that term are now obsolete, the existence of the aphasic syndrome described by that name has been established beyond doubt. It was studied most thoroughly by Kurt Goldstein (1917). Spontaneous speech as well as understanding of spoken language are, as a rule, considerably reduced in cases with marked echolalia. Arnaud (1887) was the first to distinguish two types of echolalia which may be observed in the same patient; the one consisting of automatic repetition of words which were not understood; the other in which apparently automatic repetition helped the patient towards understanding the words spoken to him. Pick (1902) followed up Arnaud's observations in studying the changes which automatic echolalia underwent in the course of restoration of speech. Compulsive parrot-like repetition changes into "mitigated echolalia," i.e. questioning repetition of the words heard.

That type of echoing may become modified by introduction of the first person singular into the sentence repeated by the patient, and may be followed by an intelligent response to the question or order. With complete restoration of the understanding of spoken language, the tendency to repetition disappears. Clinical observation of suitable cases confirms Pick's description of the various phases of echolalia. In cases in which the restoration of understanding is incomplete, the echo-reaction becomes stabilized in one or the other phase. The transition from automatic echolalia into almost deliberate repetition argues against the assumption that the automatic echo-reactions are fundamentally different from the others.

In 1935 the present writer* reported on a hitherto unknown phenomenon in cases of "transcortical aphasia" which seemed to throw new light on the nature of the echo-reactions. It was first observed in a 60-year-old woman with a right-sided hemiplegia whose spontaneous speech was reduced to the recurrent utterance "te-te." Understanding of spoken language was almost completely lost. Automatic speech, such as counting and singing, could be elicited by appropriate stimulation. The patient could not repeat spoken language intelligently on order, but she showed marked echolalia. The latter occurred only in the conversational situation, i.e. when the patient was addressed. If the examiner turned his back to her and spoke to himself or to somebody else, however loudly and slowly, she did not echo. She did so, however, when her eyes were covered so that she could not see whether or not she was addressed. The same behaviour was observed in other aphasic patients with echolalia. It proves that echolalia is not indiscriminate automatic repetition of words heard, but depends on a specific setting, i.e. the conversational situation.

Completion phenomenon.—If the examiner spoke to the patient sentences of simple contents slowly without completing them, the patient responded, as a rule, not with echolalia, but with completion of the sentence. Sometimes she would echo the last word spoken by the examiner and then spontaneously complete a sentence.

Specimen responses: ("How did you sleep last . . . ?") "Night" or "Last night." ("You are a good . . .") "Woman." ("Shake . . .") "Hands."

When there was a variety of possibilities open to her for completion her responses varied according to her mood and to the situation, e.g. ("Life is . . .") "Hard" or "Good" or "Difficult." ("The weather is . . .") "Fine to-day" or "Bad to-day." ("What did you have for . . .") "Supper" or "Lunch" or "Breakfast," according to the time of day. Grammatical mistakes made on purpose by the examiner in the sentence to be completed, tended to inhibit the completion response. The patient also reacted to changes in the meaning of sentences, e.g. the sentence "Life is . . ." was invariably completed by her according to her mood, but she was perplexed and did not react at first when the sentence was worded "Mr. Life is . . ." However, after a moment's hesitation, she continued "A man."

The completion response was always a spontaneous reaction and appeared

* "On Transcortical Aphasia," paper read at the International Neurological Congress in London, 1935, *Zeitsch. ges. Neur. Psychiat.*, 1936, **156**, 778.

to be as automatic and compulsive as echolalia. The patient showed marked signs of satisfaction when she had succeeded in completing a sentence which she had never been requested to complete. Even if she had, her lack of understanding of spoken language would have prevented her from appreciating such an instruction.

If the examiner completed a sentence himself the patient started accompanying him from the moment she would have been able to take over.

The completion phenomenon has never been found missing by the author in cases of aphasia with echolalia since it was first observed. With the restoration of understanding the completion phenomenon undergoes changes similar to those of echolalia. Automatic completion is superseded by a probing, sometimes questioning, continuation of the sentence, not unlike the reaction which one would expect of a healthy subject who, owing to lack of attention, does not fully appreciate what he is expected to say. With progressive improvement of speech the spontaneous completion response becomes more difficult to elicit and gradually disappears.

The completion phenomenon in cases of lost or greatly impaired receptive speech is of interest for a theory of understanding of spoken language. It suggests that the patient, although unable to understand, has some knowledge of what the other person is saying and intending to say. That knowledge is not identical with what is called understanding of spoken language; but the capacity of producing, within limits, what the interlocutor is going to say appears to be a precursor of full comprehension.

Compulsive repetition could in those cases be replaced by compulsive completion of schemata of thoughts and sentences, given suitable experimental conditions. The interchangeability of, and the overlapping between, echolalia and completion phenomenon suggested that the psychological mechanism underlying both reactions was the same. Even without consideration of the completion phenomenon, the old conception of echolalia as reflex repetition of words heard appeared unsatisfactory, as the repetition was, as a rule, confined to the conversational situation, which implies a specific relation to the person uttering the word. (Exceptions to that rule will be discussed later.) The compulsive completion of sentences and thoughts into which echolalia could be changed did not fit into the theory that the latter was simply an expression of a primitive tendency to automatic imitation. In completing sentences of another person with whom the patient has established rapport in the conversational situation, he is making that person's intentions his own and is thus able to follow them to their conclusion, provided the thoughts expressed and their formulation are within the range of his knowledge and speaking abilities. The mechanism underlying the tendency to adopt another person's intentions and to act like him was called "identification" (Freud, 1922). The present writer (1935) proposed that the completion phenomenon and echolalia were instances of identification on a primitive level. That concept, unlike the previous ones, took into account the condition under which echolalia occurred, as well as the completion phenomena. Schneider has later (1938) adopted the same interpretation of the echo-reactions.

The completion phenomenon described here requires also to be considered

in the light of the Gestalt psychology, to be understood more fully. By completing sentences spontaneously the patient showed the tendency to change a "bad Gestalt," i.e. an incomplete structure, into a "good" one, i.e. a complete structure. Completion phenomena, especially in visual and auditory perception, played an important part in the foundation and development of Gestalt psychology. Reference to that aspect will be made later in this article.

Echo-reactions in Low-grade Mental Deficiency with Incomplete Speech Development.

The study of the speech of the idiot seems of little value for the understanding of aphasic phenomena if one understands aphasia to be the complete or partial loss of the normal faculty of speech. If, however, we regard aphasia as the lack of symbolic formulation and expression (Head, 1918) and take into account the regressive character of aphasic reactions, as recognized first by Hughlings Jackson, the rudimentary language of the low-grade mental defective becomes a matter of great interest in the study of acquired speech disorders. There can be no doubt about the relationship between the language of the idiot and certain early phases in the speech of the child. The former can be regarded as speech arrested at a certain phase of its development.

The supposition that there is an intimate relationship between aphasia and the rudimentary speech of the mental defective is borne out by the study of echo-reactions. The various stages of echoing as seen in aphasics can be demonstrated in low-grade mental deficiency. The completion phenomenon corresponding to the type of echolalia present could also be elicited in those cases, and both were used by the patient as a means of learning to speak, in a similar way as they are used in the early stages of childish speech.

The following cases are examples from a considerable number of low-grade mental defectives with echo-reactions whom the writer has observed in the course of his studies.

CASE I.—Seventeen-year-old male low-grade mental defective with major epileptic fits.

The patient showed echolalia, echopraxia, and echographia. He had athetoid movements in the upper extremities and spontaneous movements of the neck, reminiscent of torsion spasm. There were no pyramidal signs. The patient showed the sucking reflex, but no grasping. Echolalia occurred only in the conversational situation, and echopraxia and echographia only when personal rapport had been established. Understanding of spoken language was very limited. Simple orders were carried out and questions which the patient could understand were answered, as a rule, without echoing. Correct responses to more difficult questions or orders which he could still understand were often preceded by echolalia. Otherwise echolalia was the only reaction to spoken language. Usually the word most stressed in the sentence was repeated. Foreign words were echoed with great accuracy. The completion phenomenon could easily be elicited. The patient spontaneously completed the sentences correctly, provided they were within the range of his speech, which was very limited. Completion was, as a rule, preceded by echoing of the part of the sentence spoken to him. He showed the same tendency when serial numbers, letters of the alphabet and parts of nursery rhymes were spoken to him. It was comparatively easy to teach the patient sentences which he learned to complete spontaneously.

Extract from examination records.—"What is your name?" "Name? Peter H."—"How are you?" "Are you. Very well, thank you."—"Any

pain ? ") " No pain."—" Where do you live ? ") " Live."—" Crichton Royal ") " Royal."—" How old are you ? ") " Old ? ten."—" How old are you ? ") " Are you."—" What is the time ? ") " What is the time ? Twenty minutes past eight " (incorrect).—" Are you a good boy ? ") " Good boy, that's a good boy."—" Write your name " " Write your name." (Pt. takes the pencil and writes his name in capital letters.)—" Shut your eyes ") Does so without echoing.—" All right ") Opens them.—" Where is your ear ? ") " Ear ? " Points to his left ear.—" Where is your nose ? ") Points to his nose.—" Where is your left hand ? ") " Hand ? " Raises both hands. He is unable to distinguish between right and left.—Subsequent orders to get up, to sit down, to put out his tongue, etc., are carried out promptly without echoing.—" 1, 2 ") " 1, 2, 3, 4, 5, 6."—" a, b ") " a, b, c, d, e, f."—" (Bonjour ") " Bonjour."—" (Guten Tag ") " Tag."

Completion phenomenon.—" How . . . ") " How are you ? Very well, thank you "; or, on another occasion, " How old are you ? "—" What is your . . . ? ") " Name ? Peter H."—" Are you a . . . ? ") " Are a good boy ? "

The patient completed sentences in a foreign language after they had been spoken to him four to five times. He also learned to count in a foreign language. When a story was slowly read out to him he repeated the words emphasized and accompanied the reading by echoing. The patient was shown familiar objects with the question " What is this ? " or " What do you call this ? " When he could name the object correctly (e.g. handkerchief, spectacles, matches, tie, pencil, keys, cat) he did so without echoing ; but he echoed the question when he could not name a pound note shown to him.

When the examiner spoke to himself, for instance looking at his watch and remarking on the time, the patient did not echo although he seemed to listen attentively.

Echopraxia.—Patient reacted with echopraxia to such actions only which he could carry out fully himself in the particular situation. He did not echo manipulations with objects which were not at his disposal. His behaviour proved that, in this case at least, echopraxia was not an indiscriminate automatic repetition of actions seen. The patient was echopractic only if the action he observed fitted into his " total situation."

Specimen responses.—The examiner successively coughed, whistled, got up from the chair, sat down, sneezed, put his tongue out, stamped his foot three times, tapped on the table four times. The patient, without being requested to do so, repeated those actions promptly and correctly. When the examiner took out his watch and wound it, or took his spectacles off, or opened his purse or cigarette case, the patient, though following those actions attentively, did not even attempt to repeat them. However, when a coin was put on the table in front of the patient and thrown into the air, he promptly took the coin and repeated the action. When the examiner pinched patient's right hand he immediately pinched his own right hand. He did exactly the same when the examiner pinched his own right hand and he repeated other actions on his own body which the examiner performed on himself. When imitating the patient never trepassed beyond his own body. He did not reciprocate actions carried out against himself, but imitated or completed them on himself.

When the examiner pulled his tie out the patient, who on that occasion was not wearing a tie, did nothing ; on the following day, when he was wearing a tie, he repeated the action immediately.

Completion phenomenon.—When the examiner only initiated an action familiar to the patient without carrying it out, the patient, on his part, completed it.

Echographia.—The patient could, to order, write his name in capital letters and some letters of the alphabet. He could read only a few letters contained in his Christian name. When a pencil and a piece of paper were lying in front of him and the examiner wrote single letters or made simple drawings, the patient spontaneously copied them.

CASE 2.—*Low-grade female mental defective, aged 26.*

The patient had major epileptic fits in childhood. Her speech had not developed beyond the ability to form short sentences in telegram style and to understand

simple questions or orders. Familiar objects were named correctly. There was marked echolalia and the completion phenomenon could be elicited.

Specimen responses.—("You are a good girl") "Good girl."—"You are a . . .") "Good girl."—"Get up") Patient does it without echoing.—The patient had her hair cut on the previous day. ("Who has cut your . . .") "Hair? Hairdresser."—"What is your name?") "Mary."—"How are you?") "Very well."—"Open your . . .") "Mouth."—"You are a silly . . .") "Girl."—"What date is to-day?") "Is to-day?"—"How long have you been in hospital?") "Hospital?"

When the examiner turned his back to the patient and spoke in a similar manner as before, no echo-reactions ensued. When, however, her eyes were covered so that she could not see that she was addressed, she echoed promptly and completed sentences. The patient sang nursery rhymes when the beginning of a rhyme was sung to her.

There was marked echopraxia and a tendency to complete familiar actions initiated by the examiner. She followed the doctor's actions in the ward with great interest and tried to imitate them, even when they had not just been carried out; for instance, she would take the reflex hammer from a tray and test her patellar and ankle jerks, or take a needle and stroke her sole. On two occasions she took a spatula and a torch, opened her mouth and carried out the movements that she had seen the doctor carry out in the examination of the pharynx. She also imitated activities of the nurses. The selective nature of echopraxia was very marked in this case.

CASE 3.—*Low-grade mental defective, aged 47, with infantile hemiplegia.*

The patient showed mitigated echolalia and the corresponding phase of the completion phenomenon. Often her echo-reactions were similar to those of a normal subject who is inattentive. The patient spoke little spontaneously. Her sentences were of the telegram style. Understanding of spoken language, although limited, was better than in the cases described above. Naming of simple objects was intact. She could read and write short words.

Specimen responses.—"When were you born?") "When I was born? 1889."—"What sort of weather are we having to-day?") "Weather? It is raining, isn't it?"—"Have you got any children?") "Children? I am not married."—"Why do you repeat everything I say?") "Beg pardon. I did not listen."—"I have a new suit") "Oh, you have a new suit, doctor."—"I have a brown wallet") "Brown wallet."—"Have you stolen a lot?") "Stolen? I am a good girl."

In this patient whose understanding of spoken language was fairly good, the completion phenomenon could only occasionally be elicited and if it occurred, it was of the probing, questioning type. For instance, ("Open your . . .") "Mouth?" and does it.

The similarity between the mitigated echo-reactions of this patient and those of a normal subject in a state of inattention was very obvious. It was noteworthy that the patient herself explained the tendency to repetition as due to lack of attention. She appeared to repeat in order to understand better. If, however, her attention was stimulated by the provoking nature of what was said to her, mitigated echolalia was either followed by an intelligent response or she answered without echoing.

Other cases observed showed reactions similar to those described above. In some of them, especially in those with very rudimentary speech, the sucking reflex was present. A considerable proportion of low-grade mental defectives with echo-reactions were either subject to major epileptic fits or had had such fits in childhood.

Echo-reactions in Chronic Epileptics.

It has been pointed out above that a considerable proportion of mental defectives who showed echo-reactions were epileptics. Echoing is sometimes observed in cases of chronic epilepsy who are not mentally defective. It occurs in the state of clouded consciousness following major fits and also in

epileptic twilight states. Occasionally it can be found as a habitual reaction in advanced epileptic dementia when mental activities in general, and speech in particular, are slowed down. Provided the disturbance of consciousness at the time of the examination was not too severe, the completion phenomenon, too, could be observed in epileptics.

It seems that echolalia in epileptics was seen more frequently by the old psychiatrists than now-a-days, when the frequency of fits is reduced by anti-epileptic treatment. Tuke (1876) spoke of the "echo-sign in the epileptics" and described it as a typical post-convulsive phenomenon in chronic cases.

Echo-reactions in States of Clouded Consciousness.

In states of clouding of consciousness due to brain lesions or intoxication, echolalia often occurs. It has been described in cases of coal gas, barbiturate and alcohol poisoning, and in various forms of delirium and coma. The occurrence of echolalia during the restoration of consciousness after a major epileptic fit has been mentioned above. If return of consciousness is gradual the transition from automatic to mitigated echolalia can sometimes be observed. Echolalia is, of course, possible only if the disturbance of consciousness is not too deep to prevent the perception of outside stimuli. The completion phenomenon could occasionally be elicited in states of clouded consciousness.

Schneider (1938) has noted the occurrence of echolalia in the hypoglycaemic coma induced therapeutically. Mayer-Gross and the present writer (1945) have pointed out that it is apt to emerge in a phase of the awakening from hypoglycaemic coma in which paraphasia and a tendency to clang associations and iterations were also present. Echolalia was more frequent in cases of relatively quick recovery of consciousness from insulin coma. Sometimes the patient tended to echo words or even noises not directed to him. It is clear that in that condition the patient is unable to differentiate between words directed to him and to others. He behaves like the aphasic patients whose eyes are closed. The occurrence of echolalia in insulin coma has no relationship to the clinical type of the psychosis. It is noteworthy that the stage of consciousness in which echolalia sometimes makes its appearance in the awakening from insulin coma is preceded by a phase in which the sucking reflex can often be observed. Those two phases may overlap. The co-existence of sucking and echoing is obviously not incidental, as both are primitive oral reactions to outside stimuli.

Echo-reactions in Catatonics.

The echo-reactions in acute catatonics impress the observer as even more automatic than in other conditions. Mitigated echolalia, in which the patient repeats apparently with a degree of understanding, is uncommon in those patients. Only on two occasions has the writer observed the completion phenomenon in acute catatonic states. The rarity of the latter and of mitigated echolalia in acute catatonics is obviously due to the fact that they imply a degree of mental co-operation which those patients do not as a rule provide.

Echo-reactions can sometimes be observed in advanced cases of chronic catatonia. They may be present over many years, but they cannot be elicited with the same regularity as in aphasics and mental defectives. They are subject to the same variability as cataleptic phenomena and schizophrenic mannerisms. The writer has observed two cases in which echo-reactions became permanent symptoms in deteriorated catatonics many years after the onset of the psychosis. Both patients, prior to their illness, had been intellectually backward, though not grossly defective. This is of interest in view of the occurrence of echo-reactions in low-grade mental defectives. The following is a short report on the case observed recently.

CASE 5.—*Male chronic catatonic, aged 45.*

Has been in hospital since he was 20. He started talking at the age of three and was always regarded as somewhat dull and backward. His progress at school was below average, but he could express himself very well and learned to read and write without much difficulty. He left school at the age of 14 and went to work on a farm. His employer described him as a good worker, though slow in the uptake. No intelligence tests were carried out, but the history was suggestive of high-grade mental deficiency. At the age of 16 he became odd, lost interest in his work and isolated himself. His condition grew gradually worse, his habits became faulty and he had impulsive outbursts. On his admission to hospital in 1922 he presented the picture of a deteriorated catatonic. He did not speak spontaneously. When questioned he replied very slowly and in monosyllables. He had periods of inaccessibility during which he was mute and negativistic. A few years later he became very noisy and was destructive at times. In 1937 echolalia was first noted and has remained very marked since. He also shows echopraxia. Catalepsy with *flexibilitas cerea* are present.

The echo-reactions in this patient are very similar to those seen in low-grade mental defectives with incomplete development of speech, but they are less constant. He would often, with or without echoing, answer a simple question correctly or comply with a request to which, on other occasions, he would respond only with echolalia. When addressed by the doctor he would often add "Sir" to the words echoed, thus giving his reaction a conversational character. He did not echo when not addressed. The completion response could be elicited as a rule, but sometimes it was missing when he failed to establish rapport with the examiner. When echoing or completing sentences he sometimes made additions referring to the doctor or himself.

Specimen responses.—"It is cold to-day" "It is cold to-day, Sir."—"How long have you been here?" "Been here?"—The following day he replied to the same question "A good long time."—"Do you like it here?" "Like it here?"—"Do you hear voices?" "Yes."—"What do they say?" "Say?"—"What is your . . . ?" "Name?" The following day he responded to the same words with "Birthday?"—"How do you like being . . . ?" "In here?"—"Write your name!" "Write your name."—"Write your . . . !" "Write your name, you fool!"—"It is rather . . . !" "Rather cold to-day, I think."—"You are a silly . . ." "Silly fool."—"1") "1, 2, 3."—"a") "a, b, c, d."—The patient sings the National Anthem and a nursery rhyme without being requested to do so when they are begun by the examiner. When addressed in a foreign language he always echoes, sometimes adding "Sir."

The patient imitates simple actions carried out by the examiner, such as getting up, sitting down, raising an arm, tapping on the table, etc. However, when asked to write his name or words on dictation he only scribbles about. Otherwise his echopraxia is of a similar type to that of the first case of mental deficiency described above.

It is interesting that in this patient, who in all probability was a high-grade mental defective, the schizophrenic deterioration resulted in a regression to a

level of speech observed in low-grade mental defectives. Without the aid of the history the patient could easily be mistaken for such a case.

Echo-reactions during the Early Stages of Speech Development.

Echolalia during the early stages of speech development is well known to the psychologist. A tendency to imitation of gestures, inarticulate sounds and the inflection of a voice can be observed at as early an age as eight months. Articulate echolalia rarely occurs before the age of two. Echolalia is very marked in some children, while it may be completely lacking in others. Froeschels (1918) suggested that the emergence of echolalia in childhood depended upon a discrepancy between a strong impulse to speak and a poor ability to understand. Children in whom the impulse to talk is weak in the early stages of speech development, as well as those whose understanding is fairly advanced, are not likely to show marked echolalia.

In echoing words and actions the child identifies itself with persons of its environment, and especially with those to whom it is attached emotionally. Piaget (1932) has pointed out that the element of play is of great importance in the initiative behaviour of the child. He differentiates between ego-centric and socialized functions in the language of the child and does not agree with Janet and Baldwin, who regard the childish imitation as a confusion between the "I" and "Not I." According to Piaget, the game of imitating, although it seems to apply a social attitude, is essentially ego-centric. He believes that the copied movements of words have nothing in them to interest the child and that there is no adaptation to anyone else. "The child does not know that it is imitating, but plays his game as if it were his own creation. That is why children up to six, when they have had something explained to them, and are asked to do it immediately afterwards, invariably imagine that they have discovered by themselves what in reality they are only repeating from a model. In such cases imitation is completely unconscious." Piaget's observations prove the enormous power of the tendency to identification in childhood. According to Freud, identification is for the greater part an unconscious process. As it implies a relationship to another person it is a fundamentally social mechanism. The game of repeating words heard is one of the means in which the child identifies itself with its models.

The echo-reactions of the child are not as compulsive and automatic as in aphasia or mental deficiency. They depend a great deal on the child's mood and on its willingness for imitation. They also show a considerable selectivity. The same applies to the completion phenomenon which can be easily elicited in young children. Like the adult aphasic or mental defective, they show a tendency to carry on with sequences initiated by another person and they avail themselves of it for the purpose of learning speech patterns. The readiness of the child to imitate speech and to complete sentences is one of the most important means of teaching a child to speak. With the progress of spontaneous speech and understanding of spoken language, reactions corresponding to mitigated echolalia and its counterpart of the completion phenomenon make their appearance. Those reactions can also be observed long after speech

is fully developed whenever a difficulty in understanding arises. Such difficulties may be due to lack of comprehension or of attention. It can be seen from those observations that echo-reactions in mental defectives have much in common with those of the normal child.

Echo-reactions of the Normal Adult in States of Fatigue and Lack of Attention.

In conditions of drowsiness and fatigue when attention to external stimuli is low or diverted, and comprehension of spoken language suffers as a result, the normal subject sometimes shows echolalia, usually of the mitigated type. In those states he may even occasionally respond to words not directed to him. Sometimes such reactions can be elicited by speaking to a person who is in a state of awakening from natural sleep. Another instance is the, usually mitigated, echolalia which may occur when a person whose full attention and interest is taken up by his own thoughts or by some other pre-occupation, is addressed unexpectedly. He either would not respond at all or he only half listens, in which case he may respond with mitigated echolalia; for instance, the question "What is the time?" may not elicit any response; or it may be echoed automatically without being answered, or it may provoke mitigated echolalia ("What the time is?") followed by an appropriate reply. In persons who are in a state of reduced alertness to outward stimuli, characterized by the layman as "absentmindedness," such reactions are not uncommon and have become a topic of popular jokes.

Conditions in which the normal subject encounters difficulties in understanding what is spoken to him may result in the emergence of echo-reactions, especially when, at the same time, attention is faulty. One of those conditions is the stage of learning a foreign language when understanding is still incomplete. In that stage the student is in a situation not unlike to that of a patient suffering from auditory aphasia, and he will often find himself repeating automatically, although not necessarily aloud, a question or a request directed to him, before responding intelligently. Mitigated echolalia, often almost deliberate, is not uncommon in that situation. In those echo-reactions of a person grappling with a foreign language, the mechanism of identification with the interlocutor for the purpose of better understanding of spoken language is obvious. There is also a tendency to verbalization and completion of sentences offered incomplete, as if to make sure of full comprehension. Those reactions lack the compulsive character of the corresponding reactions in pathological cases. With progressing command of the foreign language they cease to occur, but they are more liable to reappear in states of fatigue and inattention than in the mother tongue. It is of interest in this connection that cases of aphasia in polyglots have been observed which showed echolalia in the last-learned language only (Bateman, 1870; Pick, 1916; Schneider, 1938).

DISCUSSION.

The conditions under which echo-reactions are observed have the following features in common; an impulse to speak on the one hand, and incomplete development or impairment of expressive as well as perceptive speech on the

other. That constellation can be demonstrated in the various states listed above. The conditions under which echopraxia can be observed are similar. There is an urge to act and an impairment or incomplete development of spontaneous activity. Probably the emergence of echo-reactions depends on a certain quantitative relationship between urge and impairment.

Some notes on the psychology of echo-reactions.—Echo-reactions in their various forms have above been interpreted as expressions of a primitive tendency towards identification with other persons. They are fundamentally social reactions and, in their automatic form, rudiments of such. The observations in children justify the assumption that when we first learn to use speech as a means of social intercourse we identify ourselves with those who are speaking to us. In that stage of speech development, and under certain abnormal conditions, repetition of spoken words often precedes intelligent response. The patient with the automatic form of echolalia does not get beyond the stage of repetition, i.e. identification with the interlocutor. Automatic echolalia can be described as a rudimentary response to being addressed in the conversational situation. Repetition preceding the response to spoken words can be observed in normal conversation only when the speech mechanisms are not functioning fully. It may also occur in a normal subject when, owing to difficulty of comprehension, an immediate intelligent response is impossible. An example of such a reaction is the semi-automatic or even automatic repetition of questions put to a candidate at an oral examination.

Echopraxia has its normal corollary in the unconscious imitation by a normal subject of another person's movements, especially when he is watching with intense interest and is instinctively putting himself in the other's place.

The question may be asked whether echo-reactions are not sufficiently explained as imitation phenomena, and whether anything is gained by introducing the concept of identification. Echo-reactions are, of course, instances of imitation on a primitive level and may be regarded as expressions of an instinct of imitation postulated by some writers. But by calling them imitation phenomena we do not go beyond the purely descriptive and almost tautological. In characterizing them as instances of identification on a primitive level we are introducing an interpretative term; we are referring to the underlying mechanism which implies a certain emotional relationship to the model and thus accounts for the selective nature of the echo-reactions as far as the situation and the choice of the model are concerned. The fact that echo-reactions often occur only relative to certain persons has also been illustrated in Schneider's case material. It is well to remember that identification is the mechanism underlying the phenomena of suggestibility.

The term identification refers to the social aspect of the echo-reactions. That interpretation has to be supplemented by an examination of the phenomena from the point of view of Gestalt psychology. The great value of that approach for the formal understanding of the completion phenomenon is evident. Gestalt psychology also throws light on the dynamics of echo-reactions. Lewin's (1927) and Koffka's (1932) studies of behaviour are of particular interest in the analysis of echolalia and the associated completion phenomenon. A person who is addressed becomes, with the interlocutor,

part of a "behavioural field." The words spoken to him call forth tensions demanding discharge. Normally those tensions are released by an appropriate response. If this is impossible, owing to impairment of comprehension or of other faculties, the forces tending to "close the gap" in the total situation may lead to the emergence of at least a rudimentary response. Lewin called those tendencies "quasi needs," in analogy to the biological needs of the organism. Those "quasi needs" are created by events or objects which have the character of an appeal. In this terminology, words directed to a person produce the "quasi need" for an appropriate response. A pattern of a sentence offered incomplete calls for completion. The beginning of a sequence of numerals, of the alphabet, of a song, appeal for continuation. Echolalia can be regarded as an attempt at "closing the gap" in the conversational situation. Viewed from that angle echolalia, too, is a completion phenomenon.

The primitive level of mental activities on which automatisms take place reveals forces at work in the behavioural field which otherwise can be demonstrated only under carefully selected experimental conditions. However, it would not be possible to interpret fully the specific features of the echo-reactions on those lines without introducing the concept of identification which throws light on the nature of those forces.

Echo-reactions in schizophrenia, especially in catatonic states have been observed in association with signs of automatic obedience and other automatisms. They have been interpreted as due to the inhibition of intentions in the presence of a surplus of impulses, and as illustrations of the impotence of genuine activity (Mayer-Gross, 1928). They often co-exist with signs of negativism. The recognition of the fundamentally social mechanism of identification underlying the echo-reactions throws some light on their occurrence in schizophrenic states. They are expressions of an impulse to maintain social contact, however rudimentary, in a condition which is otherwise characterized by withdrawal from social intercourse. The co-existence of features of those contradictory attitudes is typical of the schizophrenic ambivalence which, in the sphere of psycho-motor activities, is most marked in the catatonic states. The form and nature of the echo-reactions are characteristic of a regression to a very early stage of behaviour. What has been said of the echo-reactions in early infancy by Janet and Baldwin, i.e. that they belong to a stage of development in which there still exists a confusion between the "I" and "Not I" applies equally to the schizophrenic regression in which the boundaries of the ego have broken down.

The description of echo-reactions as instances of automatic obedience given in current text-books is correct only in a physiological sense, in that the patient, under certain conditions, obeys a stimulus. Psychologically the response is not one of obedience but a mixture of refusal to respond appropriately and a rudiment of co-operation, whereby the former attitude dominates the situation. The behaviour of a child who has learned to speak but would react to words spoken to him with parrot-like repetition would be regarded as one of obstinacy and spite rather than of obedience.

Physiologically, echo-reactions have been classified by Wyllie (1894) as reflex phenomena. Pick (1902) regarded echolalia as a conditioned reflex

without, however, analysing the conditions under which it arose from the psychological point of view. In his view echolalia is a sign of the re-emergence of an infantile acoustico-motor speech reflex which is an important mechanism in the normal process of learning to speak. He regarded the echolalia of the aphasics as a release phenomenon due to loss of certain inhibiting functions of the left temporal lobe.

Automatic echo-reactions are primitive reponses illustrative of the over-excitability of the organism in conditions of disintegration of nervous functions, described by Goldstein (1942). The patients are "tied to the stimulus."

Echo phenomena are examples of automatisms in which the transition from the automatic to the almost voluntary and purposeful reactions can be observed. They illustrate Hughlings Jackson's contention that there is no antithesis between the automatic and the voluntary, and that there are only degrees from the "most automatic" to the "least automatic" which is the voluntary. The progress of evolution, according to Jackson, is from the former towards the latter, while dissolution progresses in the opposite direction. Either development can be demonstrated in the various phases of echolalia. Jackson's thesis of the fundamental unity between automatic and voluntary forms of behaviour bears out the necessity for the psychological study of both groups of phenomena.

Jackson pointed out the relationship of certain forms of automatisms to emotional states and illustrated this on many cases of aphasia. The fact that echolalia occurs only in the conversational situation when personal rapport has been established is of interest in this connection, as personal rapport implies a degree of emotional relationship to the interlocutor. The observation that many patients echo only when addressed by certain persons points even more strongly to the part which the emotional factor plays in the conditioning of echo-reactions.

Echolalia has sometimes been confused with palilalia. Both phenomena have occasionally been observed in the same case. It is doubtful whether they are closely akin, and whether Brissaud's (1899) description of palilalia as auto-echolalia refers to more than a superficial similarity based on the tendency to repetition which they have in common. Critchley (1927), comparing the two phenomena, emphasized the absence of aphasia in cases with palilalia. He has pointed out that the latter is a disorder of speaking rather than of speech and is to be regarded as a purely motor mechanism similar to the festination of gait. Psychologically, palilalia lacks the social element inherent in echolalia. However, conditions leading to palilalia have something in common with those in which echolalia occurs, first of all the slowing up of mental activities, and sometimes clouding of consciousness. Both phenomena have been observed to co-exist in cases of post-encephalitic Parkinsonism (Bürger and Mayer-Gross, 1928; Critchley, 1927). They have in common an underlying tendency to repetition, but they belong to different levels of mental activities, that of echolalia being much lower than that of palilalia. This is also borne out by the not infrequent co-existence of echo-reactions with such primitive reflexes as sucking and grasping (Schneider's syndrome).

Pathology.—There is no unanimity about the localization of lesions respon-

sible for the emergence of automatic echo-reactions in pathological cases. Goldstein (1917) regarded frontal lobe lesions as important, while Pick (1916) expressed the view that echolalia was the result of a loss of inhibition of speech impulses due to destruction of the left temporal lobe. Kleist (1934) maintained that lesions of the basal ganglia were responsible for echo-reactions. However, in view of their primitive nature a localized lesion alone, even if very extensive, is unlikely to produce them. Bastian's (1890) statement that echolalia can only be found with general impairment of cerebral functions is borne out by clinical as well as pathological observations. The present writer has only in one case of marked echolalia carried out a post mortem examination. It was the aphasic patient described above in whom the completion phenomenon was first observed. A thrombosis of the left middle cerebral artery was found, which had resulted in destruction of the whole speech area. The softening extended into the putamen. Cases such as this suggest that what was left of speech could hardly have originated in the dominating hemisphere. Hughlings Jackson expressed the opinion that automatic speech originated in the right hemisphere. According to him the left hemisphere is the "creative," the right the "automatic." Whether a lesion of the basal ganglia is necessary for echolalia to arise can only be decided by a series of anatomical investigations of suitable cases.

SUMMARY.

The various conditions in which echo-reactions occur have been reviewed. Echo-reactions do not consist of indiscriminate repetition, but depend on personal rapport. The selectivity of echo-reactions, with regard to both the person imitated and the actions repeated, has been demonstrated. The fundamentally social nature of echo-reactions has been pointed out. The tendency of the patients with echo-symptoms to complete automatically sentences and actions initiated by the persons with whom they have established contact has been described. Those completion phenomena are an alternative to, or superimposed on, echo-reactions. The psychological mechanism underlying echo-reactions and the associated completion phenomena is that of identification on a primitive level. The various phases which echolalia and the associated completion phenomenon undergoes in the course of the evolution and re-evolution of speech have been demonstrated. A new interpretation of echo-reactions in schizophrenia has been advanced. They are to be understood, from the psychological point of view, as the result of an impulse to maintain social contact co-existing with the opposing tendency to extreme autism. An unusual case of chronic catatonia has been reported in which echo-reactions existed over many years. This patient, who had been a high-grade mental defective, had in the course of his psychosis regressed to a level of speech corresponding to that of low-grade mental deficiency. Echo-reactions in infancy and those occurring under certain conditions in normal adults have been discussed. The conditions in which echolalia occurs have been found to have in common an urge to speak or act, a tendency to repetition and an incomplete development or impairment of expressive as well as perceptive

speech. The conditions for echopraxia are similar but concern motor activity. The echo-reactions have been analysed from the point of view of Gestalt psychology, which throws light on their formal as well as dynamic significance. The pathology and some aspects of the physiology of echo-reactions has been discussed. The part played by the emotional element in their conditioning has been considered in the light of Hughlings Jackson's studies on automatisms.

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EMOTIONAL INTERPLAY AND DOMINANT PERSONALITIES IN THERAPEUTIC GROUPS: OBSERVATIONS ON COMBINED SCHIZOPHRENIC-NEUROTIC GROUPS.

By F. KRÄUPL, M.D., D.P.M.,

Netherne Hospital, Coulsdon, Surrey.

THE observation and treatment of neurotic patients in groups has attracted much attention in recent years. Schizophrenics have occasionally been included in such therapy groups, and favourable results with them have been reported by Blackman, Foulkes and Lewis, Schilder, Wender and others.

The purpose of the present paper is to describe two group settings in which either half the patients (Group I) or a majority of them (Group II) were schizophrenics, and to comment on the mode of response, the interpersonal relationships and the emergence of dominant personalities in these groups. Emphasis will be laid on those observations which seem to distinguish group from individual treatment. The short duration of the group courses does not justify any comment on their possible therapeutic effect, or on factors which appeared either favourable or unfavourable in this respect.

The schizophrenics chosen for participation were male patients, and they had to fulfil a number of negative criteria. Patients with hallucinations, systematized delusions, marked paranoid trends, low intelligence, strong thought disorder and pronounced apathy were excluded. All the schizophrenic patients selected had either received insulin treatment (about 40 comas) before the group meetings started, or they were undergoing it during the period of group observation.

The groups met once a week for approximately $1\frac{1}{2}$ hours. They were informed in the beginning that the purpose of the meetings was to stimulate the discussions of personal problems and to improve their social adjustment. The therapist was mainly observant, and only took part in the discussions in order to guide them, to sum up or to clarify special points. Direct answers to questions, lecturing or leadership were avoided.

OBSERVATIONS.

Group I.

The first group was formed in September, 1945, and met altogether six times. The group consisted of four schizophrenic and four neurotic patients. The schizophrenics took part in all meetings; the neurotic participants varied except for one (E—), who attended all sessions.

The ages of the schizophrenics ranged from 17 to 25 ; the neurotic ages were higher and varied from 35 to 50.

The discussions of the first group meeting were recorded and are here presented in outline.

The conversation was opened by a schizophrenic, who related his personal difficulty in making social contact. He was afraid that people observed him unfavourably and criticized his general manner and appearance. Very soon all the group members admitted, spontaneously or after prompting, that they were either suffering from a similar feeling of social discomfort or that they had experienced it in the past. This topic established the first loose bond of fellowship in the group. It was, however, noticed that a difference of emphasis and conviction existed which divided the neurotic and schizophrenic sections of the group. The neurotics spoke of uneasiness, of being square pegs in round holes, and they realized that the difficulty was imaginary rather than real ; the schizophrenics, on the other hand, stressed that their fear occurred in almost any social setting, and they were inclined to attribute it to the reality of an unfriendly environment rather than to imagination. Two of the schizophrenics were vague and indefinite in their contributions ; one of them—a border-line case—only spoke when he was questioned, and his dread of social contact was more observable than verbally admitted.

The conversation then changed to a discussion of justified fears : the fear experienced during air raids. One schizophrenic (A—) amazed and shocked the group when he remarked that he did not feel scared at all during raids ; on the contrary, he felt elated. He could give no reason for this incongruous emotional reaction when he was questioned about it by others. The border-line schizophrenic eventually confessed a similar response to raids, although he had to admit that he felt afraid as well. His fear could, however, be banished by the simple expedient of putting his head under the bed-clothes.

There was some speculation on the possible reason for feeling elated during air raids. Youth and inexperience were ruled out as explanations by one of the neurotic patients whose 2-year-old daughter had shown considerable fear during bombing. Finally another neurotic patient (E—) suggested that A— obviously did not care very much for the world of reality and would be happy to see it "atomized." To this A— replied with an embarrassed smile : "Perhaps."

A phantasy of world destruction is not infrequently encountered in early schizophrenics. Freud, in his analysis of the Schreber case in 1911, interpreted the phantasy as an expression of the patient's frightened awareness that the libidinal cathexis had been withdrawn from the external world. A—, during individual interviews, admitted that such a world-destruction phantasy had occurred to him. His response to air raids was therefore not as incongruous as it appeared at first ; he felt relieved when the nightmare of living in a destroyed world became a reality which other people experienced with him. E—'s interpretation had hit the mark.

The further progress of this group will be demonstrated by the case records of the four schizophrenic patients and of one of the neurotics (E—), who attained a position of prestige and dominance in the group.

E—, aged 50, was a neurotic and psychopathic individual. He was admitted after prolonged alcoholic excesses with an unsteady gait, tremors and neuritic pains. His bearing was confident and self-assured, although he professed that this attitude was a defence against feelings of inferiority. He had described himself at first as a medical psychologist possessing a Ph.D. Leipzig and Sorbonne, but soon admitted that these statements were entirely untrue.

He had had a course of psychotherapy several years prior to his admission, when he was suffering from a reactive depression. He asserted that his alcoholism started then. Also his interest in psychology dated from that time, and he had, in recent years, largely lived by "giving advice and writing articles," making use of whatever psychological knowledge he had acquired.

By the time of the first group meeting he had been in hospital for four months and the symptoms of chronic alcohol intoxication had disappeared. He had impressed other patients as a person of knowledge and experience, but the stories he told were often too tall to be true.

The group was soon dominated by his personality. He helped to foster a group spirit, tried to arrange group activities and to smooth out differences which occurred between the meetings. The following episode is characteristic as an example of the confidence he inspired: A neurotic group member confessed to him that he had had an extramarital love affair, which had been the immediate cause of his symptoms. He had been unable to reveal this either to the group or to the therapist privately, and he asked E— to pass this information on to the therapist.

One of the schizophrenic patients (A—) became very attached to him and seemed to benefit from this relationship.

When the group meetings terminated E— was persuaded to leave the hospital, and nothing has been heard from him since.

A— was a 17-year-old schizophrenic with a history of peculiar and erratic behaviour for the past three years. He had twice made irresolute suicidal attempts by poisoning and had become "boorish, aggressive and rude" at home. His resentment was particularly directed against his mother, who was a fussy and nagging person.

His thoughts were vague and often blocked. He felt that people remarked he had a bad smell, and he complained of a lack of energy and interest. After 40 insulin comas there was some improvement; he had lost his hostile attitude to his parents, but he remained shy and self-conscious.

He had no difficulty in joining in group discussions, although his contributions were sometimes rather involved. When he could not make his point clear, or when he was questioned too closely, he retired from the conversation with an embarrassed smile or an attempted jocular remark. His relationship to other group members, particularly between sessions, remained on a schoolboyish level of good-natured banter and teasing. His attitude to E— was, however, noticeably different. He seemed to admire and trust E—, and was more at ease in his company than with anybody else. He adopted E—'s interest in psychology, and made plans to study medicine with the idea of becoming a psychotherapist eventually. He developed an attitude of airing some half-understood psychological knowledge in the group to demonstrate his desire to help others. Very often such psychological contributions were vague and abstruse, but this attitude seemed to help A—'s feeling of self-importance. He remained very awkward and embarrassed in female company, although he was able to learn dancing.

He left the hospital soon after the last group meeting, but had to return after about two months and then took part in Group II.

B— was a 17-year-old youth in whose case the diagnosis of borderline schizophrenia was clinched by his behaviour in the group. He had a bad family history and had been stammering since the age of six. For the past three years he had been suffering from a twitching of the right side of the face and a blinking tic. He had become increasingly shy and self-conscious. His eyes watered when he met people, even if they were only casual passers-by in the street. He also had a compulsion to touch telegraph poles.

He was a reticent observer in the group for the most part, but responded obediently when his contribution was invited. Only rarely did he intervene actively or

make a spontaneous remark, as, for instance, when he announced that he shared with A—the feeling of joy during air raids. He later admitted paranoid fears that everybody was hostile and critical towards him. His stammer was not sufficiently pronounced to account for his reticence, and his speech became almost free from stammering after a few sessions.

He improved to some extent, and this improvement continued after the group meetings had ceased. There was a temporary relapse occasioned by a brief stay at home and, on his return, he explained that he felt ashamed of his family, who were only poor labourers. He had been so sensitive about this that he had never dared to reveal it to the group. He soon regained his former level of improvement however and even accepted a part in a Christmas pantomime, although he admitted stage fright and a fear he might stammer on the stage. He did, however, quite well at the actual performance.

C— was a 25-year-old medical student, who had been a shy, ambitious and serious-minded person with a good school record up to the age of 17. Then the problem of leaving school, choosing a career and accepting adult responsibilities caused a breakdown which was diagnosed as schizophrenic. He made a fair recovery after several months and then decided to study medicine.

The structure of his psychosis was based on a re-activated oedipal conflict, but the original conflict was changed to an ideological contest. The patient, his younger sister and his mother were Roman Catholics; the father was Protestant and a medical man. When the patient started his medical studies, he began to feel that the tenets of the Roman Catholic Church were in opposition to the teaching he received, and he found it very hard to assimilate medical knowledge. It was only with great difficulty and after a few minor schizophrenic disturbances that he managed to pass his pre-clinical examinations.

He was also distressed by a compulsion to masturbate excessively. He made a pilgrimage to Lourdes, confessed his sins to several priests, but he could not conquer the sexual urge. He became emotionally attached to various girls, and this also aggravated his perturbed condition.

When he had to attend lectures on gynaecology the situation became unbearable for him. On several occasions he openly opposed his clinical teachers and voiced his religious objections. Eventually he had an acute psychotic episode; he felt himself surrounded by enemies, jumped out of a first-floor window and shouted that the time of resurrection had come. He was admitted in this state as a temporary patient. He had 43 comas, and towards the end of his insulin treatment joined the group meetings.

In the group situation the emotional constellation of his overt conflict was fairly well copied. The therapist was not a Catholic, and C— made it clear from the start that he could not accept the therapist's authority on that score; the only true authority for him was the Roman Catholic Church. He told the group of one of the incidents which had disturbed him prior to his breakdown, when he had felt compelled to argue against the interruption of pregnancy in an epileptic woman because it was contrary to Christian ethics. He tried to defend his point of view again, but the group members refused to be drawn into an ethical argument. They wondered why C— should have felt so strongly about the incident. Eventually a neurotic patient, after casting about for the right word, characterised C—'s attitude as "rebellious."

At the fourth group meeting the same emotional conflict led to a violent demonstration of hostility directed against the therapist. C— opened the discussion in an excited mood and referred to a previous debate on the significance of dreams. During that debate C— had asserted, against the opinion of the rest of the group, including the therapist, that dreams were quite nonsensical and without meaning. He had since consulted a priest, who had confirmed that it was unjustified to look for a meaning in dreams. How could the therapist defend a theory which was contradicted by the Church? He argued fiercely, and during the whole group session prevented the consideration of any other topic. At the end he announced that he felt an outsider who impeded the progress of the group and he would not attend further meetings. He was asked by the therapist not to make a hasty decision, and was assured that he was not a disturbing element in the group.

At the next meeting C— apologized for the disturbance he had caused. He had

seen the priest again, and it turned out that he had misunderstood the priest's opinion on the question of dreams.

This emotional outburst had a beneficial effect on C—'s subsequent behaviour in the ward. He began to display his medical knowledge, and was pleased when patients approached him for some medical information. The conflict of Church versus Medicine was not mentioned again.

When he left the hospital he was advised to have further psychological treatment, if possible, by a Roman Catholic therapist. He did not follow this advice, yet a letter received from his father a year after his discharge reported a "good recovery." He had resumed his medical studies and had shown great interest in them.

D—, aged 24, had been mentally disturbed and unable to work for six years. His fear of a hostile environment had recently caused suicidal speculations. He had always felt inferior because of a rheumatic heart lesion, and was surprised and gratified when he learned that his heart was strong enough for him to have a combined insulin and electric shock treatment. He had 38 comas and 6 E.C.T. without any disturbing incident.

He took an active part in group discussions, but regarded the meetings as of little consequence compared with insulin treatment. He was engaged to a girl four years his senior and, although he had broken off the engagement before his admission, he now met her every day. He never joined in any group activity apart from attending the sessions, and therefore remained more or less an outsider.

He left the hospital prematurely as soon as his insulin course came to an end, and has not replied to follow-up letters since.

Group II.

In this group the schizophrenic patients were always in the majority and the number of participants was not limited to eight as in Group I. New patients, schizophrenic or neurotic, were introduced at times and others allowed to drop out.

The group met eight times, and seven of the schizophrenic members attended five or more meetings. The ages of the schizophrenics varied from 17 to 33, the younger ages prevailing; the neurotic ages ranged from 29 to 49, but one of them was only 15.

A record of all meetings was kept and the salient events will be reported. It is not possible to give more than a sketchy outline of the observations made, and only significant happenings can be mentioned.

First meeting, 7.i.1946. Present: 6 schizophrenics and 1 neurotic.

After a long initial silence the schizophrenic patient Z—, although handicapped by stammering, opened the discussion with the question: Why is it that people feel anxious in crowds? He denied that he felt such an anxiety; he only wanted to put a problem for discussion. The response by the group was rather cautious and hesitant; yet several members, including the neurotic patient, admitted that they had experienced anxiety in crowds. It seemed that such an anxiety was linked with a fear of becoming the centre of attention. Z— revealed that he once felt an urge to smash the cups in a café. This remark by Z— was not in keeping with the preceding trend of a halting conversation and another silence followed.

The therapist then put the question whether there was an association between a fear in crowds and the present situation in the group? Were they afraid to speak up because they would become the centre of attention then?

This elicited an enumeration of further fears by various patients. The neurotic patient attempted to fill in gaps in the conversation by mentioning personal experiences, by commenting on those of others, or asking for contributions by silent members. Z— remained out of tune with the rest of the group, and his occasional remarks were not taken up.

Second meeting, 14.i.1946. Present: 6 schizophrenics and 2 neurotics.

The discussion, for the greater part of the session, was lively, as a problem was considered that was not personal and yet concerned them all. They criticized the hospital regulations concerning Occupational Therapy. Several complaints and some constructive proposals were made. The neurotic patient, who was a newcomer and who had taken part in a previous neurotic group, opposed the other members and rated them aggressively for being lazy. The group took this accusation very calmly. Y—, a patient who had recovered from a schizophrenic episode, explained that it was not laziness that had prompted them to criticize the O.T. arrangements; they would all welcome having regular physical exercise instead of O.T. Eventually it was agreed upon that the group should bring definite proposals with regard to O.T. and other communal activities which they would like to arrange among themselves.

Then the new neurotic patient put his problem of feeling guilty and inferior because he was an illegitimate child. The group showed a sympathetic understanding of his feelings.

The rest of the session was taken up by a hesitant debate on the relationship between sexual and guilt feelings. They arrived at the conclusion that the feeling of guilt was due to the way in which they had been sexually enlightened in adolescence. The lead in this discussion was taken by Y—.

Third meeting, 21.i.1946. Present: 6 schizophrenics and 2 neurotics. One of the schizophrenic participants had been discharged and the newcomer was A—, who had been a member of Group I and had just been readmitted to hospital.

It was noticed that Z—, who had started the discussion at the first meeting, selected a chair in the furthest corner of the room. In all subsequent sessions he stuck to that place and refused to join the circle formed by the other patients.

Definite proposals regarding O.T. were put to the therapist by one of the neurotic patients. There was a short discussion, in the course of which the therapist was called away.

When he returned he found an animated conversation in progress, which had been started by A— in an attempt to gain prestige by airing a superficial knowledge of psychopathology. A— had stated that there was a definite connection between the sexual urge and nervous breakdowns. Three members disagreed with this statement and explained why it was not applicable in their own case. A— stuck to his point and tried to expound an over-simplified Freudian theory. He was rudely interrupted by the illegitimate neurotic; economic factors were at least as important as sexual ones in causing nervous diseases. If sex played a role, then it was only because of the way in which society dealt with such problems as abortion and sterilization. The rich could afford it, but not the poor.

Y— attributed his illness to Army discipline and his resentment of Army doctors, who had treated him as a malingerer. People in authority had always caused him to feel frightened. But he had other fears too; the fear of being alone in a room, of people making adverse remarks about him, and of being attacked by someone who approached him from behind.

This remark prompted Z— to make, from his corner seat in the background, a comment which, as so often with him, was only related to the fringe of the conversation; he had never had a fear of being attacked from behind, but at one time he had a peculiar "compulsion." When he lifted a glass or a cup to his lips, he had to jerk it over his shoulder. He mentioned that he had certain fears which occurred always at the same time, namely, at four o'clock in the morning. He could, however, not divulge the nature of these fears; they were too personal.

Fourth meeting, 28.i.1946. Present: 7 schizophrenics and 2 neurotics. Two new schizophrenic patients had joined the group; one of the former members was temporarily absent.

One of the newcomers, X—, was a paranoid schizophrenic who, during a more acute phase of his illness, had felt that people accused him of being a homosexual. As a result he had developed a defensive attitude designed to emphasize an aggressive masculinity. With men he was either snobbishly aloof or insolently arrogant; in female company he acted the part of a Don Juan.

During his short stay in the ward he had already aroused the hostility of most of the other patients, and to have him as a group member was a welcome oppor-

tunity for them to show how they disliked him. Y— and the illegitimate neurotic led the attack. The other neurotic participant tried to be conciliatory and to mediate between X— and his opponents.

X— defended himself with restraint, although some of his replies were biting and personal. He explained that he had been slandered in the Army, where everybody was against him and where he had learned that the struggle in life was an individual one; that everybody had to fight against the rest of the world. He was asked if he had been as aggressive before he joined the Army. X— denied this, and revealed that he had been a conscientious objector, but his claim had not been recognized. He had to endure ill-treatment and hardship in detention barracks until he finally changed his mind and accepted non-combatant duties as a stretcher-bearer.

This story produced an unexpected result. His chief opponents admitted that they admired X—'s stand for his principles and that the work of a stretcher-bearer was not a "cushy" one. The general atmosphere became more peaceful, and X— continued his account of a peculiar persecution in the Army; his past was dug up by his comrades who turned against him when they discovered he had been a conscientious objector; he was spied upon and followed everywhere.

A—'s conduct during this meeting was odd. At first he joined the critics of X— and gave some examples of the latter's unfriendly behaviour. But he seemed ill at ease; the attitude he had adopted during the preceding meeting of being a man of psychological knowledge had completely disappeared. When X— started to relate some of his Army experiences, A— interrupted and annoyed him by an involuntary giggle, for which he had to apologize. When X— finished his account with the nonchalant description of how he had knocked down a stranger who had made insulting remarks behind his back in a pub, A— felt compelled to say that he never got roused by insults and could not be bothered by them. This was obviously untrue, and merely expressed his desire to show that he was superior to X— in this respect. He soon had to alter his statement and then told his story of continuous quarrels at home, how he had become more and more moody, and eventually had wandered off from home and lost his memory.

Fifth meeting, 4.ii.1946. Present: 6 schizophrenics and 3 neurotics.

The meeting started with the request by a schizophrenic member to discuss his problem of choosing a career. He wanted a secure job, which did not involve competition. He had, however, no interests, except reading thrillers and listening to jazz music.

The discussion dragged on slowly. The question of fear of criticism was introduced, but the contributions remained few, short and cautious. The presence of X— and the fear of his adverse remarks evidently inhibited the free flow of conversation.

Eventually a neurotic newcomer asked leave to bring up a question which was unconnected with the preceding discussion. He was a 15-year-old boy who looked effeminate, had broken down through anxious overstudy, and who assumed an aggravating attitude of precocious prudence. The question he put was: Should the male sex be stronger than the female sex?

The first response of the group was one of perplexity. They wanted to know why he was interested in this question. He could not explain this; he had asked other people the same question, but no one had so far been able to give him a satisfactory reply. X— then turned on him rather sharply: "If you could give birth to a child, assuming you were anatomically suited to the job, would that not bring home to you that women can be stronger than men?" The boy was rather embarrassed and had no answer.

Sixth meeting, 11.ii.1946. Present: 8 schizophrenics and 2 neurotics.

The discussion remained on a superficial careful level and finally came to a full stop. The hostility against X— seemed to take the form of passive resistance instead of the previous frank opposition. The therapist remarked on this and the discussion livened up slightly.

A— mentioned that he felt upset when he had to pass a couple who were obviously in love. Pressed to say why he should feel distressed then, he confessed that such a situation roused sexual phantasies in him and he often put himself in

the place of the girl in his phantasies. The neurotic and effeminate boy was prompted to admit similar thoughts. He added that he was frequently regarded as girlish.

Sex became the topic for a while until A— asked whether sexual attraction between men was not just as frequent as between men and women. The question remained unanswered, but a short discussion followed of the limits to which premarital relationship between young people should be allowed to go.

Seventh meeting, 18.ii.1946. Present: 8 schizophrenics and 3 neurotics.

There was a renewed demonstration of open hostility against X—, whose behaviour during a recent dance had antagonized everybody. X— had collected a number of female patients around him and had kept them amused by loud and sarcastic remarks directed against any male patients who came near. When this behaviour was sharply criticized by the group, X— countered that he had got so used to knowing that everybody disliked him that he had become quite indifferent to the opinion of others. It was soon made clear to him, however, that he was all but indifferent. He was told that he deliberately behaved in a way that was bound to cause enmity in others.

The neurotic boy was the only group member who had attempted to be friendly with X—, but even he had to admit that the task was difficult. X— would never speak to him first; he might even pass him by without a glance. On the other hand, X— had a great influence over him; he had sometimes caught himself unwittingly imitating X—'s behaviour.

X— seemed flattered, and asserted he had always been able to influence people. Other members were by no means so pleased, and they made no secret of their feeling that the boy's behaviour had made him almost as disagreeable as X—.

Later during the session there was a discussion of masturbation, which caused X— to declare that masturbation was "unmanly." He subsequently boasted of his potency, and that he once had had intercourse five times in a single night.

At the end of the meeting the question was raised whether a group of eleven members was not too large and unwieldy. The therapist promised to consider dividing the group. This suggestion was welcomed, and Y— asked if they could decide among themselves who should be together in a group.

Eighth meeting, 11.iii.1946. Present: 5 schizophrenics and 3 neurotics.

There had been an interval of three weeks since the last meeting as the therapist had been away from hospital. On his return he found that some changes had occurred during his absence. X—, whose disregard of hospital rules had become too infectious, had been asked to leave the hospital. Most of the other schizophrenic members of the group had also been called to task on account of disobedience and unruly behaviour.

The meeting started with a prolonged silence, which was followed by a tardy enumeration of symptoms. Then there was a short consideration of the question of a possible physical origin of their symptoms.

Eventually the therapist requested the group to tell him the reason for their obvious resistance. The answer was given by Y—, who stated he could not talk in front of people he either disliked or did not know well enough. Why did the therapist not abide by the former decision to divide the group?

Y— was supported by all the other schizophrenics. The outcome was that the schizophrenic members left the room in a body to wait until the remaining group portion had finished their session. The three neurotics who were left seemed relieved and a fairly lively discussion ensued, during which much fellow-feeling, sympathy and a desire to make helpful suggestions was obvious.

Then the five schizophrenics reassembled. Y— took the lead with a confession. He had been stealing goods while he was in the Army. They were goods he had no need for, and which he gave away later. He felt ashamed and guilty about it, and did not know what had tempted him to commit these delinquencies, which were never discovered. He suggested that there might perhaps be an association with his attitude towards people in authority of whom he had always been afraid and whom he hated and rebelled against. He mentioned particularly his hatred of a certain sergeant-major and his fear of being unfairly criticized. He had always felt compelled to work very conscientiously to obviate criticism.

A— also admitted that he had frequently been stealing, but he had never had

any guilt feelings about it. He only feared detection. He went on to connect the fear of being found out with the anxiety he had often felt that his parents might notice he had masturbated.

Z— was the next one to confess that he had been stealing at one time. It happened after the death of his mother when he was sent to live with his grandparents.

These confessions were made haltingly, and repeatedly there were long pauses. Towards the end of the session there was, however, a more lively exchange of ideas and of symptoms which had not been mentioned before.

A short description of the behaviour of seven of the schizophrenic members follows to supplement the picture of the effect of group attendance.

A—, aged 17, had taken part in Group I. During his brief absence from hospital he had read several psychological books. The scanty knowledge he acquired had evidently done him no good; it had stirred him up, yet offered him no assistance in dealing with his chaotic psychosexual condition. In the group he revealed glimpses of his conscious sexual fantasies and these pointed towards passive homosexual tendencies. He fell, however, in love with a schizophrenic girl, and this made him moody and tearful. During the three-weekly interval between group sessions his behaviour became difficult and antagonistic. The therapist, on his return, found a note in A—'s case-sheet that he had behaved like a "thoroughly naughty boy who sides with everybody who grumbles." A— had not attended O.T., had stolen a wallet from another patient, and had proposed to the schizophrenic girl. He had been reprimanded for his offences and this had not improved his condition.

A week after the last group meeting A— had an acute schizophrenic episode, during which he was under the influence of frightening hallucinations. It was necessary to give him one electric shock to remove the acute disturbance. It was then learned from him that the psychotic interlude had been provoked by an erotic experience—during a social gathering in the hospital a female patient had sat on his lap and had kissed him.

A— was able to leave the hospital shortly afterwards. A psychoanalyst had been found for him, and a report from her six months later stated that he had improved to some extent, but that his condition remained variable.

B—, a borderline schizophrenic, aged 17, had never left the hospital after his participation in Group I. He formed a close friendship with W—, a member of Group II, and after the meetings had come to an end these two patients were constantly seen together. B— was the passive partner in this friendship, which had, however, a beneficial effect on him.

The two friends left the hospital together to work jointly on a farm. But this did not last long. After a week they found the work too strenuous and the living conditions too uncongenial. They left the farm and parted company.

Four months later B— wrote to the therapist asking if he could join a therapeutic group at an out-patient clinic. He mentioned that he felt better, although he still had occasional "bad spells" when he felt "quite as bad as ever."

His friend W—, aged 19, was of high intelligence, but without aim and purpose in life. He had first shown mental symptoms at the age of 13, and since that time had been attracted by younger boys, whom he took out to tea and for walks, in spite of the comment which this conduct aroused at school. He tired, however, quickly of all his boy friends.

In the group he was, on the whole, a merely passive observer. His friendship with B— and its brief duration has been mentioned above.

Eight months after his discharge he had found a job as librarian and was said to be doing "quite well."

Z—, aged 20, had shown neurotic symptoms and peculiarities of conduct since the age of three. He had always retreated from difficulties in life into daydreams and minor ailments. A thought disturbance had gradually developed which, as he said, "blurred the meaning of objects" immediately around him. He had unusual hobbies: reading military biographies and collecting old weapons.

He remained isolated in the group, both physically and mentally. He sat away from the others, and his contributions to the discussion were often inconsistent with the preceding topic and unconnected with the general mood of the group. He never revealed the contents of his phantasies, to which he alluded several times; he felt they were too intimate and personal to be publicly exposed.

He went to a private mental hospital later, and a report about him after eight months said that his condition had not changed.

X—, aged 23, had developed a paranoid psychosis in the Army. He felt himself accused of homosexuality and, to prove the opposite, became arrogant and hostile with men. In female company he affected an ostentatious Don Juan attitude.

After he had joined the group all group proceedings were influenced decisively by him. He got along fairly well with the few neurotics members, but the other schizophrenic participants soon revolted against him in a body. They refused to submit to hospital regulations from which X— had exempted himself high-handedly. Eventually X— had to be asked to leave the hospital, and this restored the peace to some extent. The unity of the group could, however, not be re-established.

Eight months later it was learned that he had gone to Belgium after a quarrel with his father. He was about to get married to a Belgian girl.

Y—, aged 28, was discharged from the Army with the diagnosis psychoneurosis. Soon afterwards he developed acute schizophrenic symptoms, which necessitated his admission to hospital.

In the group he was co-operative, but reserved. He could not stand silent stretches, and usually revived a conversation that had died down. Although he talked freely about his personal problems, there was much that he could never reveal.

He led the attack on X—, and became the mouthpiece of the hostile schizophrenic subgroup. This incident had an unfavourable effect on him. He revolted against hospital discipline, to which he had adjusted quite well in the beginning. He had more frequent attacks of anxiety, and was more distrustful of people than before.

He has improved greatly after leaving the hospital, but has retained some minor neurotic symptoms.

U—, aged 22, has suffered from recurrent schizophrenic episodes since the age of 16, and had had thyroid treatment without effect. He improved after a tonsillectomy.

He took part in only a few group meetings and then asked to be excused from further attendance. The problems discussed disturbed him, and he preferred shutting out all unpleasant themes.

COMMENTS.

The events which take place in a group setting are so complex and intricate that neither a full description nor a ready evaluation of their significance and implications can be given. Even in individual psychotherapy the bilateral relationship between doctor and patient is so full of variation and dynamic interplay that it is notoriously difficult to convey an adequate picture. This difficulty is increased in reporting the events occurring in a group with its multilateral and fluctuating relationships. To overcome this it appears advisable to view the events from selected angles, so that the confusion of simultaneous occurrences is reduced to some order which provisionally neglects complexities for the sake of clarity of presentation.

It is therefore proposed to consider the observations which have been made under the following three headings:

- (1) Mode of response (intellectual, motor, emotional).
- (2) Inter-personal relationships.
- (3) Dominant personalities.

1. *Mode of Response.*

Intellectual response.—The primary problem that confronts and unites the group appears in a cognitive or intellectual guise. The patients want to know the answer to certain questions. Do others share symptoms and experiences which they have found distressing? How can emotional handicaps be avoided or patterns of faulty behaviour be improved? Is there a solution to their personal problems? What is the cause of their symptoms? And so on. The number of topics that can be brought up for discussion is great, but some themes which are of general interest and application recur frequently, e.g. the similarity or dissimilarity of their symptoms, attitude towards problems of sex, anxiety or hostile reactions in certain situations, etc.

Only a few examples of the topics discussed in the two reported groups have been mentioned. The first meeting of Group I, for instance, illustrated in outline the conversation aroused by a symptom shared by all members, viz. social anxiety. Discussion of such general themes which concern all participants is helpful in creating a feeling of group solidarity, mutual interest and sympathy.

The patients were encouraged to work out for themselves the problems they raised, and no authoritative opinion or advice was generally offered by the therapist. Some authors (Marsh, Snowden, Maxwell Jones, Wender) have, however, reported good results from a method of group therapy that consisted in, or at least included, lectures on mental hygiene. It appears that the therapeutic aim in purely didactic groups is a limited one. It may be beneficial for patients with somatic anxiety symptoms to listen to a course of lectures illustrating the physiological mechanisms operative in their illness. Maxwell Jones demonstrated the efficacy of this method of treatment in soldiers suffering from the so-called effort syndrome. Some patients may derive benefit from an instruction in psychopathology and certain social problems, or from advice concerning healthy social attitudes, but the value of such a purely didactic approach is doubtful in more severely disturbed patients or in schizophrenics.

The unknown is full of dangers for the schizophrenic; to know more might reduce his fears. The patient A—seemed to regard psychiatric knowledge as the magic clue that might solve all problems. He was an intelligent boy, and read a number of books on psychotherapy. The result was, however, not at all beneficial, although it had the temporary advantage of providing him with an interest that counteracted his apathy. It also increased his self-confidence for a time. But, on the whole, the store of psychological knowledge of which he was so proud was of little help to him, and in the crucial relationship to the other sex it seemed to have been definitely detrimental.

Motor response.—The emphasis in group treatment can be put on activity, or communal activities, as was done by Slavson in his "activity groups" and to some extent also at Northfield (Main, Bridger, Foulkes). To engage in a common task fosters a group spirit which is capable of alleviating social anxieties and handicaps (Bion and Rickman). Other authors have made use

of group performances to induce cathartic abreactions, e.g. the psychodramatic methods of Moreno and this school, and the group projection methods of Maxwell Jones.

It was intended to encourage the two groups under observation to undertake communal activities, but this plan was not successful. In Group I some outings were arranged, but a common constructive task was never achieved. Group II did not attain sufficient coherence at any time to embark on activities in which all members would willingly join.

During the group meetings the conative urge was mainly restricted to verbalization. Patients experienced this as a desire to participate in any discussion which roused their interest. If they could find no opportunity to join in the debate, or if their inner inhibitions prevented them from it, they felt frustrated and dissatisfied. Once or twice schizophrenic patients openly admitted their fear of talking in the presence of others. Frequently they waited until another patient had touched upon a problem akin to their own, and then they followed his lead when they had reassured themselves that no condemnation or criticism had been roused. They felt relieved when they succeeded in thus revealing a guilt-charged conflict or anxiety which they had previously concealed from everybody.

It was obvious that group discussions could stir up emotional conflicts for which the debate offered only an insufficient outlet. One patient, U—, admitted this frankly, and used it as a plea to be excused from further group attendance. In other instances the emotionally unsettled patient resorted to "acting out," i.e. to irrational and disturbing activities outside the group setting. This possibility of acting out is an unpleasant eventuality in any type of psychotherapy, but in group treatment the risk of its occurrence seems to be increased, because the personal response of a patient can never be assessed with the same degree of accuracy and validity as in individual psychotherapy.

Furthermore, the possibility of acting out is likely to be much greater in schizophrenic than in neurotic patients. This was particularly evident in Group II, in which the schizophrenic members predominated. The resentment and hostility which actuated the schizophrenic part of this group found insufficient relief in free discussion, but led to acting out in open antagonism against all authority and hospital regulations. During an interval of three weeks, when there were no group meetings, these schizophrenics became such a disturbing element in the hospital that administrative measures were taken against them. The chief culprit, X—, was asked to take his discharge, and similar steps were contemplated with regard to the others. The friction that resulted increased the conflict in some of these patients and caused a temporary deterioration of their mental condition.

Emotional response.—Some emotional reactions have been mentioned in the preceding paragraphs, such as the effect of participation or non-participation in group debates, and the stirring up of conflicts through the discussion of emotional topics. Other affective responses will be considered later under the heading of inter-personal relationships.

It remains here to examine the emotional effect of the group setting as

such, and whether there is any significant difference in the emotional atmosphere of the group as compared with individual psychotherapy.

Most methods of group treatment have as their chief aim the correction of faulty emotional patterns of social response. Wender compared the group setting with the family environment encountered by the young child. He expressed the opinion that "in the group there is undoubtedly a transference of tendencies originally directed toward parents and siblings." He spoke of the "catharsis in the family" as being a potent factor in the therapeutic efficacy of group treatment.

This view is evidently correct, but the same transference reactions are also active in individual psychotherapy and do not distinguish group treatment from it. In Group I the patient C—abreacted emotionally the hostility and rebellion which was originally aimed at his father, and which in the group was focused on the therapist. This incident would certainly have occurred in individual treatment as well. C—'s emotional outburst was a transference phenomenon, but not one that was aroused by the group setting as such. On the contrary, the collective opposition of the group might easily have daunted a less perturbed patient, and prevented him from giving free expression to his feelings.

It is doubtful whether any feelings are operative in a group setting which do not occur also in a group of two, i.e. in individual psychotherapy. It appears, however, that certain emotional responses are favoured by the group environment, and occur with greater strength and frequency in group than in individual treatment. This is particularly the case with two reactions of opposite feeling tone—the feeling of security in a tolerant and friendly society on the one hand, and the fear of an antagonistic and hostile environment on the other.

There is little doubt that the group offers a feeling of greater social security to many patients than does individual therapy. The patient has the support of others who are similarly handicapped when he confronts the therapist. In an individual interview his anxiety is likely to be aroused by a feeling of being under continual scrutiny, whereas in the group he has the opportunity of retiring into the role of a silent observer. This is an advantage that is particularly welcomed by schizophrenic patients, yet one is repeatedly surprised at the amount of significant information which even tongue-tied patients are enabled to volunteer in the group, and which would have remained suppressed for a much longer time in individual interviews.

The opposite type of emotional response, the fear of a hostile environment, is not alleviated to the same extent in schizophrenics as in neurotics. Schizophrenic patients never attained the same degree of social ease, and their contributions remained hesitant and guarded.

2. Inter-personal Relationships.

The individuality of a patient is not lost in the group; on the contrary, personal features and symptoms are thrown into greater relief. Whatever happens in the group acquires a very personal significance for the individual

patient, rouses feeling and idiosyncrasies, and activates conscious and unconscious conflicts. He is involved in an intricate tissue of emotional threads that unite or separate the various participants. The dynamic contacts operative in the group are multilateral, as contrasted to the bilateral relationship in individual psychotherapy; they allow a much wider field of emotional responsiveness. Bilateral relations are, of course, not absent; the passing feeling that is aroused by one or the other participant may crystallize into a more permanent friendship or animosity. The emotional inter-relationship may also connect three or more patients. Such emotional constellations among a limited number of participants are naturally influenced by the group setting as a whole, but from the point of view of the individual member involved in such an emotional constellation, the rest of the group is a vague actuality without individual personalities. It seems that it is impossible for any one patient at a given time to establish an inter-personal relationship with more than a limited number of others and yet remain conscious of those other personalities; when the number is more than four, or perhaps five, the idea of a group configuration seems to replace the awareness of definite individualities.* If, for instance, a community of feeling is established in the whole group excluding the therapist, the individual member will be conscious only of the personality of the therapist, and of the existence of a community to which he belongs and which confronts the therapist.

The feeling induced by the group as a whole has already been indicated above. There still remains a great variety of theoretically possible inter-personal relations in which the awareness of the personalities taking part is retained. There are for example in a group of nine, 36 different ways in which any two members might combine in emotional relations. The figure for possible groupings of three or four patients are 84 and 126 respectively. In reality this confusing wealth of possible combinations is never realized. Certain permanent relations among the participants soon evolve in a group, and limit the possible occurrence of further emotional sub-groupings; the group has then acquired a definite emotional structure.

Bilateral friendships which establish themselves in a group seem to be more stable than relationships among three or more members. Examples of the former type were the friendships between A— and E—, and between B— and W—. The active partner in such relationships would try to have a place near his friend during the group sessions, and they would continue their association in the intervals between group meetings. These bilateral friendships are thus to some extent opposed to the formation of a wider group community. An example of a grouping together of five patients occurred in Group II, but it only lasted as long as they were united in the common aim of opposing X—.

Apart from the variety of possible groupings, two other factors have to be considered in inter-personal relationships in a group—the type of emotional response and its intensity.

Freud demonstrated that social feelings derive from a number of different drives among which attenuated sexual tendencies, identifications

* This may also be assumed by inference from Spearman's Law of Limited Mental Energy, and the psychological experiments which demonstrate the limit of the perceptual span.

and modified aggressive impulses play the main role. All these tendencies could be observed in the two groups.

Feelings of friendliness and affection were of great importance in the formation of group unity. That these affects have a sexual derivation is not immediately apparent among normal people. Schizophrenic patients, however, show a greater admixture of uninhibited sexuality in their social activities. Homosexual tendencies, repressed or partially conscious, were therefore very noticeable in our groups, and particularly in Group II. On the other hand, a group setting counteracts the urgency of sexual tendencies, and can thus temporarily relieve symptoms which have been developed in defence against unconscious homosexual desires. X— demonstrated this most clearly. His usual overbearing conduct in male company served the purpose of obviating possible sexual temptations. In the group the need for this defensive symptom was less acute, and he was therefore far less aggressive during group meetings than otherwise.

Examples of identification were noticed in the form of imitative behaviour, and of assimilation of a new ego ideal. These identifications were only superficial, but they were able to exert a noticeable influence on the patients' behaviour. A—'s desire to become a psychiatrist and the way in which the neurotic boy in Group II copied the behaviour of X—, whom he admired, are illustrations of the mechanism of identification in the group.

Aggressive tendencies in the attenuated form of rivalry and competitiveness serve to increase the emotional coherence of a group. A more direct expression of aggressiveness was operative in Group II and made the establishment of group unity impossible.

There remains another type of inter-personal relationship to be considered which is pathological in origin, but which seems to be of importance in the dynamic interplay of a therapeutic group setting. This relationship exploits the presence of other persons for the sake of gaining relief of some inner conflict, both conscious and unconscious. Examples of this type were numerous, but variable in the form in which they were expressed.

Some patients who had not the courage to reveal a personal problem would put significant questions to others in the hope of finding that they were not alone in suffering from that particular conflict or symptom. If they succeeded their anxiety was lessened, and the emotional support they thus derived allowed them to confess their own difficulties. Sometimes these questions had a less conscious and deliberate origin, but disclosed a conflict of which the questioner was not yet fully aware.

The act of confession itself, even without previous attempts at finding a fellow sufferer, often implies a similar exploitation of the group setting. The tolerance of the group is invoked to obtain a feeling of absolution. Sometimes a patient may be grossly extravagant in self-criticism and disparagement to be certain that others will refute these unfair self-reproaches.

Patients may condemn and revile others for faults which they have strongly repressed themselves, or for actions which they dare not carry out themselves. X—'s manner of teasing and criticizing the neurotic boy for the latter's effeminacy is an example of the first kind. Y—'s hostility towards X— had its

origin partly in the fact that X— showed his revolt against authority openly, whereas Y— felt guilty about it.

Both affectionate and aggressive feelings are unifying factors in a group only as long as their intensity is not too strong. Intense love or hatred tends to disrupt the group community. There were no examples of strong erotic attachments between members of our groups, but vehement hostile feelings were at times much in the foreground. The hostility of C— in Group I was directed mainly against the therapist. He had an opportunity to abreact it and this improved his adjustment to the group. A great deal of aggression was roused by X— in Group II; feelings ran so high that this group was broken up.

3. *Dominant Personalities.*

A group of patients who meet with a common purpose in mind does not remain formless. Very soon individual characteristics introduce a stratification of dominance, with one member emerging as the most dominant personality. He will exert the greatest influence on the progress of the group, whereas other members will show a varying degree of status down to the most passive and compliant individual. Such a scale of dominance has been noticed both in hospital and out-patient groups. It appears to be a characteristic phenomenon of all group gatherings with a common purpose, and it deserves special consideration because of its general sociological significance.

Bion has made successful use of this phenomenon during the war in his so-called "leaderless groups," which were designed to throw into relief the leader qualities of the various participants. One cannot, however, simply equate the qualities of leadership and dominance. The fact that an individual is dominant in a group does not necessarily make him a leader. This was exemplified in Group II, in which the most dominant personality was also the most disruptive influence.

Several authors have described this scale of dominance in animal groups. Masserman, for instance, found that "cats placed in a competitive feeding situation in small groups . . . arrange themselves in a relatively stable hierarchy of dominance and submission with almost no actual fighting, and thereafter maintain their positions in the hierarchy with remarkably little friction." He refers to similar hierarchies which have been observed "in groups of chicken, doves, rats, cats, macaques, baboons and other animals, and have often been shown to be less dependent on mere fighting ability than on factors of alertness, initiative, manipulative dexterity and even less clearly defined attributes. . . . Observations showed that the dominance hierarchy is definitely goal-referential. Thus, an animal passive with reference to food would shoulder other animals aside in pursuit of a mouse. . . . Animals neurotically inhibited in respect of a particular goal surrendered their dominance in any group in which that goal or its equivalent was the competitive nidus."

These observations in animals illuminate some of the conditions which determine and influence group dominance. It is of interest that the position in the hierarchy depends on certain objective factors, such as the nature of the group task and the actual aptitude of the various group members in relation

to this task. In observing a group of patients one also gains the impression that their status of dominance is more or less independent of subjective desires and aspirations, but depends on objective personality factors of particular aptitude in the special group setting. Ambition to occupy the position of leadership may be present in several individuals, but such ambition remains ineffectual unless it is combined with the qualities required for dominance. The neurotic boy in Group II, for instance, strove hard to improve his status, but the only result was that he was criticized and disliked for it.

There was one interesting difference between the observations made in animal groups and the two reported patients' groups. Dominant animals which had been made "neurotic" lost their position at the top of the hierarchy. One might consequently have expected that the position of dominance in our groups would have been occupied by a relatively well-adjusted personality with few neurotic difficulties. But the actual findings were different: Group I was dominated by a psychopath, Group II by a paranoid schizophrenic, and the schizophrenic subgroup in Group II was led by a severely disturbed patient who had passed through a schizophrenic episode. It must, however, be pointed out that these two schizophrenic patients who occupied dominant positions had fairly well-preserved personalities. They had broken down under the unusual strain of Army life, and their acute psychotic symptoms were soon superseded by a character defence in one case, and by neurotic features in the other.

The nature of the particular attributes required to make a patient the dominant influence in a group which meets for the purpose of social readjustment remains obscure. E—, the psychopath, was perhaps best suited for this task. He had always shown a capacity to influence people, was impressive in his behaviour, and had been successful in posing as a qualified psychotherapist. No similar characteristics were observed in the other two dominant persons, X— and Y—.

It is evident that the reasons for the dominance of an individual in a group are very complex and that there may be no common denominator. From the material at hand one may tentatively indicate a few factors which seem to have played a role in securing the position of dominance. Both E— and X— were persons of more than average intelligence and had definite exhibitionistic character traits. They were also of superior ability in expressing themselves verbally. This verbal fluency was also relatively marked in Y—, as he was the most vocal patient in the schizophrenic sub-group he led. Intensity of feeling and singleness of purpose were further factors of significance. The character and conduct of X— were governed by the single uncompromising aim of obviating homosexual temptations. His whole life was a constant effort to achieve this purpose. Y—, on the other hand, was a person who had always been roused by oppressive authority; the arrogance of X— stimulated him to intense feelings of resentment, which provided him with the forcefulness necessary for temporary leadership.

It seems, therefore, that dominance may at times have a pathological significance. It need not be due to normal aptitudes and abilities which make the dominant person particularly suited to fulfil the group task; dominance

may be the result of emotions and strivings which are abnormally intense through a particular constellation of unconscious drives and defence mechanisms.

SUMMARY.

1. The response of male schizophrenic patients to a therapeutic group setting is reported. Two groups were observed ; in Group I the schizophrenics equalled, in Group II they outnumbered the other participants.

2. Group II was disrupted by strong feelings of hostility which were directed against one of the attending schizophrenics ; the group eventually broke into two unequal parts when all the other schizophrenic patients insisted on being seen as a separate group.

3. Inter-personal relations in a group can be multilateral. The span of awareness for multilateral contacts seems to be limited, however ; if they are too numerous the idea of a group configuration replaces the awareness of distinct personalities.

4. The emotional response aroused through inter-personal relations in a group appears to be of the same character as in individual psychotherapy.

5. There is, however, the difference that a group setting offers a feeling of greater social security and emotional support than individual interviews to tongue-tied patients, and particularly to schizophrenics.

6. The risk that patients, and especially schizophrenics, may "act out" emotional difficulties seems to be greater in group than in individual treatment.

7. The emergence of dominant personalities seems to be a general characteristic of groups with a common purpose. Some of the factors which may lead to dominance have been tentatively considered. Dominance in human groups may have a pathological origin.

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OBSERVATIONS ON SOME CASES OF EXHIBITIONISM.*

By F. H. TAYLOR, *O.B.E.*, M.D., D.P.H., D.P.M.,

Medical Officer, H.M. Prison, Brixton.

EXHIBITIONISM was stated by East to be the commonest sexual offence for which men are received into prison; this proved to be true in 1946, when 98 men charged with exposing themselves were received into Brixton Prison during the year. Exhibitionism is customarily dealt with under Section 4 of the Vagrancy Act, 1824, and the offender is charged with being a Rogue and Vagabond in that he "did wilfully, openly, lewdly and obscenely expose his person with intent to insult a female." The term "exposure of the person" is presumed to be synonymous with exhibition of the genitals. The 98 cases about to be discussed represented 32.2 per cent. of the sexual offences and 1.95 per cent. of all offences received into the prison during 1946. Exhibitionism presents a difficult problem both to the doctor and to the layman, as it is often apparently nonsensical and meaningless. All cases received into prison are specially interviewed as a routine and frequently the Court requests a report as to the accused's state of mind. In this series this was requested in 88 cases—a much higher proportion than for any other offence.

In 1924 East recorded a series of 150 cases of exhibitionists received into Brixton Prison to which frequent reference will be made in this paper, and he gave in addition figures of sexual offenders received over a period of twelve months. It is interesting, therefore, to compare these figures he gave with those for 1946 in a tabular form.

	East's series.	Present series.
All sexual offences	291	295
All other offences	7,401	4,728
Percentage of sexual offences	3.8	5.9
Exposing person	107	98
Indecent assault on females	69	78
Carnal knowledge or attempts	42	23
Indecent assault on males	37	39
Importuning	19	24
Unnatural offences against males	17	33
Reports requested by Courts on sexual offenders	101	196

The most striking difference is the increased percentage of sexual offences and the great increase in requests from magistrates for reports as to the mental condition of offenders.

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The act of exposure shows great variations from case to case. Havelock Ellis describes the exhibitionist as usually a shy and timid person, who seldom makes demands on the woman and is satisfied with the mere act and the emotion it produces; he seldom speaks or makes an effort to approach her; he may have no erection and seldom masturbates. The response of the woman may be one of fright and flight, one of indignation and abuse, or one of pleasure and amusement; in the latter case the emotion produced is the most pleasurable. Walker and Strauss state that the exhibitionist will return over and over to the same spot and repeat the act, especially if it is received by the female with a response such as giggling. Allen considers the emotion is greater if the female is shocked; he also mentions the favourite spot, usually a lonely site, such as a country lane or a railway carriage. East and Hubert are more definite and rightly stress that the maximum sexual excitement may not necessarily occur at the time of actual exposure. They describe the object as always a stranger, sometimes plural in number, of constant age, often girls in their twenties or teens. In this series all the above examples were encountered. It was quite common for the man to have a fixed object, such as one or more females in the twenties or teens, but in addition many exposures were to children. In the latter cases, males might also be present, but there were always one or more female children in addition. There were, however, several cases of exposure in crowded places or actually to a crowd. One man, for instance, exposed himself to a crowd who were waiting to see a distinguished personage visiting the "Britain Can Make It" Exhibition; another to a bus queue of schoolgirls; and yet another to several A.T.S. girls standing at the windows of their hostel. In most cases the females were strangers; but one man exposed himself to his neighbour's wife, another to his landlady and a third to his own children. Nor was the object always fixed, for several men stood or sat in public parks and exposed themselves to all passing females, irrespective of their age. In the table below, showing the nature of the objects, the adult women were most frequently in their twenties:

One adult woman only	.	.	.	.	.	34 cases.
Two adult women	.	.	.	.	.	14 "
More than two adult women	.	.	.	.	.	19 "
One adolescent only	.	.	.	.	.	3 "
Two adolescents	.	.	.	.	.	5 "
More than two adolescents	.	.	.	.	.	5 "
One child only	.	.	.	.	.	6 "
Two children	.	.	.	.	.	3 "
More than two children	.	.	.	.	.	9 "

The emotion experienced was, in general, directly related to the response shown by the women. If the latter expressed indignation, embarrassment or amusement the greatest emotion was experienced. When the exposure was to two women much greater pleasure was felt if one of them was seen to comment on the exposure to the other. In the few cases in which it was alleged that the woman showed interest or pleasure, much less emotion was experienced;

the most unsatisfactory result, from the man's point of view, was a complete lack of interest on the part of the woman.

The site of the exposure varied considerably. There were lonely country lanes, railway carriages and the windows of the offenders' homes. At the other extreme, there were busy thoroughfares, like Piccadilly, stations like Waterloo, crowds, public parks and, in particular, the entrances of public urinals. A very common site was in bombed buildings.

Thirty-one of the offenders admitted masturbation at the time of the exposure, whereas the remaining 67 denied it; 43 admitted that the penis was erect. In considering these figures it should be borne in mind that reports by the Police were usually available and that a check on the prisoners' statements could be made; they frequently changed their first story when they realized this.

Prisoners charged with indecent exposure deny their guilt more frequently than in any other sexual offence. 46 (= 47 per cent.) of this series denied the offence and many offered an excuse of some sort; in East's series 55 per cent. made a denial. The excuses offered were varied; the commonest was that they had been observed while micturating (18 cases); 5 claimed to be drunk and not to remember anything about the offence; a further 19 alleged consumption of alcohol immediately before; 8 claimed that some physical disability had caused the act, combined with micturition or alcohol. The physical disabilities were (a) genito-urinary, such as an enlarged prostate, sensitive small bladder (confirmed by catheterization at the prisoner's request), enuresis, nephritis and urethral stricture; and (b) diseases causing scratching or involving auto-examination by the man, e.g. scabies, tinea cruris and furuncle of the thigh. Other excuses offered were that they were observed while masturbating (5 cases), that there was mistaken identity (2 cases), or that they had forgotten to fasten the trousers after micturition (3 cases). At this point it is relevant to mention the rather slender evidence which is sometimes offered that a man has exposed himself. In view of the frequent denials made by men against whom the evidence is indisputable, it is sometimes difficult in less obvious cases to form a conclusion as to the real state of affairs; but there can be little doubt that there are cases in which no exposure, or at any rate no exposure "with intent to insult a female," was in fact committed. It is only fair to say, however, that the Courts tend to take a very lenient view of such cases and few are ever committed to prison.

Contrary to the findings of East, who found 60 per cent. of his series to be bachelors, the greater proportion in this series were married men. Of the 98 cases, 53 were married and 7 had mistresses or were engaged and having sexual intercourse with their fiancées; only 38 were single men. Separation, domestic strife or dissatisfaction were common among the married men as follows:

Separated	15 cases.
Unsatisfactory relations	18 "
Wife pregnant and no intercourse possible	5 "
No disharmony obvious	15 "

These figures still confirm, therefore, the important part that deprivation of sexual intercourse plays in the aetiology of exhibitionism.

The incidence of exhibitionism is greater in the younger age-groups and falls off as old age is approached. The curve was found to drop sharply after the group 30-39 years as follows :

23-29 years	.	.	.	.	37 cases.
30-39 "	.	.	.	.	36 "
40-49 "	.	.	.	.	11 "
50-59 "	.	.	.	.	9 "
60 and over	.	.	.	.	5 "

These findings correspond fairly closely to those of East, though the drop after the 30-39 year group is more marked. At the present time only males of 23 years and over are received into Brixton Prison, whereas in 1924 males of 16 years and over were received.

No less than 56 of the offenders had no previous convictions of any kind whatsoever ; 19 more had previous convictions for offences other than exposure, usually of a petty nature. One man had 21 previous convictions for larceny, drunkenness, etc. It is seen, therefore, that in all 76.7 per cent. had no previous conviction for exhibitionism. Of the 23 cases which had previous convictions for exposure, 10 had one, 3 had two, 4 had three and 6 had more than three convictions. Some of them had other convictions for non-sexual offences. In view of this relatively small percentage of recidivists—and bearing in mind that none of the 10 cases with only one previous conviction had been sent to prison—may one not again repeat East's question and ask if the effect of prison is not a strong deterrent in cases of exhibitionism ? The view that general criminality is more common in exhibitionists than in other forms of sexual offence is also supported by these figures.

There have been many classifications of exhibitionism. Havelock Ellis quotes Maeder as dividing cases into :

(1) The infantile exhibitionists, who desire to gaze and be gazed at ; (2) the seniles, who are impotent ; and (3) those indulging in exhibitionism for the purpose of invitation, and who are of definite virility.

None of the cases in this series fall into Class 1, not more than two into Class 2 and only relatively few of the remainder were exposing themselves by way of invitation. Krafft-Ebbing in his classical work (pp. 478 *et seq.*) divided exhibitionism into four groups :

(1) Acquired states of mental weakness with cerebral or spinal disease clouding consciousness and at the same time causing impotence.

(2) Epileptics in whom the act is an abnormal organic impulse performed in a state of imperfect consciousness.

(3) The somewhat allied group of neurasthenic cases.

(4) Periodical impulsive cases with deep hereditary taint.

Havelock Ellis criticizes this classification as unsatisfactory ; this is confirmed in the present series. Only two cases fall into Group 1, none were epileptic and only four cases would fall into Group 3. East in his paper divided

his cases into two groups—the psychopathic and the depraved. Adopting the same classification for this series the results were as follows :

A. Psychopathic.		B. Depraved.	
1. Psychoses	3	1. The exposure as a preliminary to an attempt at carnal knowledge	0
2. Undeveloped psychoses . .	4	2. The exposure as an attempt to debauch young children to commit a masturbatory act upon the exhibitionist . .	9
3. Psycho-neuroses	4	3. The exposure as an attempt to attract, excite or invite a female	17
4. Personality defects	14		
5. Mental defectives	2		
6. Subnormals	11		
7. Visionaries	29		
8. Alcoholics	5		
Total		Total	
	72		26

It is very difficult to fit all the cases satisfactorily into these groups and many could be placed into two or more. Comparison with East's figures, however, show a striking general similarity. It was found necessary to add a sub-group of personality defects owing to their relatively high number. These consisted mainly of psychopaths, but there were three cases of post-concussive syndrome. All the psychoses were schizophrenics. The psychoneuroses consisted of two anxiety states and two compulsive-obsessive neuroses ; this compares closely with East's five and the significance of the small number is discussed below. As in East's series there were no epileptics. The greatest discrepancy between these figures and those of 1924 is the mental defectives—2 as against 24. One can only assume that this is due to the improved detection of mental defectives nowadays by Education Authorities and the disposal of them at a much earlier age. The percentage of visionaries in both series is almost identical. In only four cases was there any strong evidence of other perversions ; this figure cannot be regarded as really accurate as the length of time available for observation did not permit of such a deep and detailed investigation as is required to discover other than very obvious perversions. Only 12 cases had had any form of psychotherapy, but 9 of these were men with several previous convictions for the same offence. The 3 who had received treatment and who had no previous convictions consisted of an anxiety state, a compulsive-obsessive neurosis and a post-concussive syndrome. All 4 cases of psychoneurosis had received psychotherapy.

In 1939 East and Hubert gave a further grouping, which is found to be much more satisfactory in use and it is relatively easy to place each case in its correct group ; a typical case history is given in each case.

Group 1.—These are the true exhibitionists, who practice exposure as a means of sexual relief in preference to any other means. They have usually been doing it for many years and it replaces, to a great extent, normal sexual intercourse. The act is often repeated ; the men are anxious and fight hard against the temptation. Treatment is sought, but often seems of little help to them. In the present series there were 15 cases of this nature ; 11 had

previous convictions and in 3 cases they had as many as seven in number. A typical case-history was as follows :

CASE 5.—Aged 61. Seven previous convictions for the same offence. He was a charming old gentleman of good education and pleasant manners. Indecent exposures commenced at puberty and had continued intermittently both in this country and in India, where his career had been ruined in consequence. He married in early life and had a family of three ; intimate relations with his wife had never been really good. At first he chose adult women, including coloured girls, as his object, but in later years all his exposures had been to children. His frequent convictions had caused continuous moves from one country to another. Treatment had been sought frequently, but had little curative effect ; he had also tried to exhaust himself sexually by frequent intercourse, but with no better result. Thinking it might benefit his condition he remarried a girl of 26 years in 1935 ; at interview this wife stated that he was completely impotent and had only achieved intercourse satisfactorily on two occasions. At the time of the present offence he was attending a clinic and had recently been a voluntary patient in a private mental hospital. He had just left court after being bound over on a charge of exposure to children, and was on his way back to the mental hospital, travelling alone in his car. He stopped, approached two female children, aged 8 years, and exposed himself to them. He was frank and co-operative at interview, and described a feeling of excitement at the time of exposure, followed by one of guilt ; he stated that he had the same guilty feeling following sexual intercourse. There was a history of being afraid of enclosed spaces and he had on several occasions commenced to disrobe whilst travelling on tubes and buses. His own psychiatrist was 'phoned and stated that he had noted the strong guilt complex, and that analysis had revealed subconscious guilt in addition. The exposures were regarded as obsessive in character in view of the inability to control his impulses, the distress caused and the failure of imprisonment to deter him. The man was so anxious about his continued offences that he suggested castration as the only possible means of ridding himself of his condition. The court again bound him over and he re-entered the private mental hospital as a voluntary patient, being escorted there on this occasion.

Group 2 consists of those who expose themselves as a prelude to obtaining sexual intercourse ; that is, to attract, excite and invite the female. Naturally the objects in these cases are adult women or adolescents, often of attractive appearance. In addition the woman is usually alone and the exposure tends to take place in a secluded spot. The male has an erection and goes through the motions of masturbation. This form of exposure is not so common as one is usually led to suppose in the literature ; in this series there were only 12 cases.

CASE 2.—Aged 27. Four previous convictions for the same offence. He was a married man, but had been separated from his wife for over a year. From his story he had a voracious sexual appetite and had frequent sexual intercourse. He was invalided from the Forces, and twelve months previously had been a voluntary patient in a mental hospital following impulsive acts of violence to others. He was discharged following an attack on a male nurse ; at that time he was not considered certifiable as insane. In this and all his previous charges his behaviour had been identical. He approached an attractive woman, between 20 and 30 years of age in a lonely part of a wood and exposed his erect penis. He admitted that his object was to obtain intercourse and though in most cases the woman ran away, he alleged that on two occasions he had been successful. He was shy and introverted whilst under observation, but his history showed frequent impulsive behaviour. He was considered to be an early non-certifiable schizophrenic.

Group 3 consists of those men who are unable to, or afraid of, obtaining normal sexual intercourse. Most of them are bachelors or married men who are separated. They ask for nothing from the woman and experience a sense of relief and satisfaction, usually at the time of the exposure. There are often

several women and the penis may or may not be erect. Sometimes a spontaneous ejaculation occurs. 21 cases occurred and 3 of these alleged a fear of contracting venereal disease as their reason for avoiding intercourse.

CASE 83.—Aged 29. No previous convictions. He was a married man with two children, and his wife had refused all intercourse for a long period, as she did not wish to have any more children; she thought that contraceptives were unreliable. He had served in the Forces, but was discharged owing to "nerves." On the morning of the offence there had been some "love-play" with his wife, but no intercourse was permitted. Whilst he was dressing he went to the bedroom window and exposed himself to passing women in the street. He was emotionally unstable and showed a very poorly integrated personality.

Group 4 was the largest group and consisted of 45 cases. These were men in whom the exposure was an isolated occurrence due to sudden temptation. They included the alcoholics and those who alleged that they were micturating when the opportunity for exposure was suddenly presented; others were masturbating or about to do so when a female was observed. It includes all the "physical" excuses and indeed most of those who denied the offence. The object was not fixed and the site was varied, but was often at or near a public urinal. Most of the men had no previous convictions.

CASE 84.—Aged 53. No previous convictions. He was a happily married man, who was on excellent terms with his wife, and had no history of any mental disorder. He was walking in the park after visiting a public house and felt a sudden urgent desire to empty his bladder. The nearest urinal was the other side of the park, so he stepped into the bushes and urinated behind a tree. As he stepped out, buttoning his trousers, he saw two girls in their late teens approaching and he exposed himself to them; he had no erection. He stated that the action was impulsive and had given him no satisfaction, at least not a conscious satisfaction.

Group 5 was a small one (5 cases) and consisted only of subnormal or defective persons. They regard exposure as the normal sexual approach to a woman, as to them it is the most easily understood. It resembles the behaviour of animals during mating, e.g. the love dance of the apes.

CASE 82.—Aged 28. Three previous convictions for the same offence. He was a dull and backward man with a mental age of $11\frac{1}{2}$ years. He had been in a mental hospital, but was never considered certifiable under the Mental Deficiency Acts. He pleaded guilty to exposing himself to a girl of about fourteen years of age whom he saw walking in the park. She aroused a desire in him, but he did not really wish for intercourse with her. He had done the same thing on former occasions and failed to regard his conduct as in any way abnormal.

A further *Group 6* was described by East and Hubert, and consisted of cases precipitated by the commencement of ordinary heterosexual life; there were no such cases in this series.

The above results are tabulated below:

Group 1. The true exhibitionists	15 cases.
„ 2. Exposure as an invitation to intercourse	12 „
„ 3. Substitution for normal intercourse	21 „
„ 4. Isolated instances due to sudden temptation	45 „
„ 5. Subnormals to whom exposure is the natural approach	5 „
Total	98 „

Exhibitionism is a product of civilization and does not occur as a rule among naked savages. In such races there is no attraction, for it is that which is hidden, and not that which is exposed, which creates curiosity. The psychoanalysts consider that exhibitionism is the result of the castration complex; Fenichel states that the man exposes himself to prove that he has a penis and subconsciously desires the woman to show him that she had not. Näcké regards it as a form of sadism; whilst Stekel considers it to be essentially narcissistic in origin. Havelock Ellis compares exposure with the actions of the flagellist when the man approaches the woman with a rod representing the penis; he describes exhibitionism as a psychic detumescence. Few cases can be regarded as psychoneurotic in origin. As already stated, only four cases, of which two were compulsive-obsessives, occurred out of 98 offenders. The act of exposure is often impulsive in nature and there is an ever-increasing urge to carry it out; but ordinarily there is no distress at giving way to the desire and no real effort to control the impulse. In addition, as has been suggested earlier, the effect of imprisonment is so frequently deterrent as to contraindicate a diagnosis of neurosis. Masturbation at frequent intervals from puberty onwards is a common history. No less than 34 men in this series volunteered that it was a habit at the time of the offence. The exposing of the organ added an increase to the excitement which they gained from masturbation, the most primitive form of sexual relief. It will be appreciated from the divergent views quoted above and from the study of the present series of cases, that no single aetiological factor can be applied to exhibitionism in general. Numerous factors, constitutional and environmental, are involved; each case must be judged on its own merits, both as regards the personality of the individual, and as regards the environment in which he customarily lives and the circumstances in which the particular offence occurred.

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OBSESSIONAL STATES IN EPILEPTICS.

By GERALD GARMANY, B.Sc., M.B., M.R.C.P., D.P.M.,

Deputy Medical Superintendent, Bristol Mental Hospital.

THE association of obsessive compulsive states with organic disease is well known and a prolific and abundant literature dealing with it has accumulated in the last twenty years. The combination of obsessive compulsive states with epilepsy, however, has received very little attention and in some of the cases in which it has been reported it has been regarded as a coincidence. This may very well be so, but the case here described is of interest in showing the combination very clearly, and it would not perhaps be very odd if there were a small group of epileptics with obsessive compulsive states, in whom both manifestations were ascribable to a common pathology.

It is not proposed in this paper to survey the literature dealing with organic disease in obsessional states, but since so much of the work done on obsessional states has been of psychodynamic kind, attention may be directed to a few of the more common combinations. Schilder (1938) states that not less than one third, and possibly even two thirds of obsessional states have an organic background, and he draws attention to the necessity, when examining these cases, of looking for signs of chronic encephalitis. He mentions slight degrees of facial rigidity and of rigidity of the flexors of the arm and draws attention to the value of a sign described by himself with Hoff, namely, that when the arms are outstretched with the eyes closed they tend to come together owing to the increased tone in the flexor muscles. Impairment of the accommodation-convergence reaction, tremor, and certain motor urges, particularly an urge to talk, must be looked for. Goldstein (1942) describes obsessional symptoms after brain injury, especially the tidiness and meticulous orderliness of some patients, which he feels subserves a protective function in minimizing the effect of daily adaptation to changing events. Though he does not stress fully developed obsessional states, these sometimes occur after brain injury, and the writer saw such a case a few years ago, following directly upon a cerebral contusion.

Studies have been made of obsessional experience during oculo-gyric crises. These attacks are, it has been pointed out, very frequent in chronic encephalitis if they are sought for, and their character varies very widely. Some have the sudden and unheralded character of epilepsy, and are uncontrollable in their course, while in others the resemblance to a compulsion is considerable, for not only is there a feeling of being compelled to look upwards, but the patient can with an effort direct his gaze elsewhere, though when the

effort is relaxed, the eyes return to their upturned position. Obsessional rumination may accompany the crises, and Wexberg (1937) describes a patient who, during his attacks, felt that two people stood behind him and discussed him, and felt as if he were trying to look upwards and backwards in order to see them. Another patient during his attack continually pondered the question of why an O was round. Creak and Guttmann (1935) have discussed the relationships of tics and compulsive utterances to chorea, stressing the fundamental nature of the motor verbal eruption and the relative unimportance of the words used. It has been thought that those cases of chorea destined later to develop tics, showed differences at an early stage, particularly a preponderance of involuntary movements around the face, and involvement of breathing, phonation and articulation. From these studies and many others the organic basis of many, though not necessarily all, obsessional and compulsive states is clear.

The relation of epilepsy to the obsessional state is, however, much less secure and evidence is of a much less direct kind. Aldren Turner (1907) and Crichton Browne (1895) both observed obsessional doubting states in epileptics between fits; and Jelliffe (1932) noted that convulsions might occur in obsessionals, developing the subject in somewhat the same way as Freud, who believed that epilepsy might represent a discharge through somatic channels of excitation too massive to be mastered in a psychic way. Recently Roubicek (1946) has made a careful study of five cases of compulsive laughter, surveying much of the literature, and drawing attention to the close link between this condition and epilepsy. Cappell and Dott (1938) recorded a case of tumour of the mammillary bodies in which subsequent examination showed that neither cortical involvement nor hydrocephalus was present. In this case frequent fits occurred after a long aura of uncontrollable and inappropriate laughter. Wilder described a case where compulsive laughter gradually merged into the aura of epileptic fits over a period of years. Wilder's case was especially interesting in that one brother of the patient suffered from epilepsy and another brother suffered from compulsive laughter, as also did the son of this brother. Electroencephalographic evidence is conflicting. Pacella (1944) has published observations on a small number of EEGs performed on cases of obsessional state. He examined 31 cases, being careful to exclude any who had had electro-convulsive therapy, or any form of brain injury or disease. 26 of the cases were psychoneurotic and 5 were schizophrenic, and it is interesting to note that two of the former suffered from *petit mal*. He records that 22 cases out of 31 had abnormal tracings and that of these 14 had convulsive type patterns, as shown by frequent runs of 2-4 c/s and potentials of high amplitude after hyper-ventilation. Rockwell and Simons (1947) divided a series of obsessive compulsives into three groups, the second of which, amounting to 10 cases, consisted of patients with severe obsessional symptoms and some affective features. These were inadequate, unstable psychopathic personalities characterized by immaturity and low ethical standards, and all had abnormal records with slow waves, which in two cases were paroxysmal. A further case in which an obsessional state and a tic were combined showed excessive production of waves at frequencies of 5-7 cycles per second. These findings

are of interest, but difficult to assess and are not yet confirmed by other workers.

Literature in the general sense yields at least two notable cases where epilepsy and obsessional states have been combined. John Cowper Powys describes his own very severe obsessional state—handwashing, a fear of knives and forks being allowed to point at his breast which was linked up with an obsessional preoccupation with the possibility of changing sex, and an aversion to cotton fabrics so strong that he was averse to the sight of either himself or another person holding a cotton handkerchief. This author describes in his autobiography how his epilepsy began at the age of eighteen and mentions several attacks which occurred subsequently. Freud tells how Dostoevski had fears of his own death as a child with many compulsive rituals to protect against the fear. His father was murdered when he was eighteen years of age, and thereafter Dostoevski suffered from epilepsy. Freud regarded this as a dramatization of his own punishment or at least as a portrayal of his guilt, and it is interesting to note that while he was incarcerated in Omsk for four years for a political offence, the epilepsy ceased. Freud believed that the imprisonment in Siberia was in itself punishment enough, and it is related that when Dostoevski was freed the epilepsy returned and indeed was worse than before.

My own case, which aroused my interest in the matter, was as follows :

The patient was a poultry farmer, aged 51. He showed no outstanding features in his childhood, which was reasonably happy, though he was a little timid and fearful of the dark, and required a light in his bedroom as late as twelve years old. His father was a well-known county cricketer, and under his guidance the patient devoted much time to cricket and other sports. He passed a scholarship and after leaving his secondary school joined his father in a leather business. He joined the R.A.M.C. in 1915, being invalided seven months later for epilepsy together with recurrent dislocation of a shoulder because of the fits. When he was 32 his father died, and a few years later he sold the business, being at that time concerned about his epilepsy and anxious to work in the open air, which he felt might help him. He and his wife retired into the country to live on a farm with a young female cousin, rendering certain services to her in return for a small grant of land. He lived on the proceeds of some poultry, together with the income from a small estate left by his father. Despite increasing personality difficulties with the cousin, who was described as "somewhat neurotic," he has remained in the same employment for sixteen years.

The family history is as follows : His father was a rigid, strait-laced man, who ruled his household with an iron hand. His mother was a quiet little woman, who died of cancer when the patient was about 20. One brother died soon after the last war, in which he was gassed and is said to have suffered from faints. The other brother still lives and was an unstable and unscrupulous person, who made sustained efforts to defraud the patient during their business partnership. The patient, in relation to his obsessional symptoms described below, said quite spontaneously that he wondered whether his brother's character, of which he was very much ashamed, was the cause of his being so fearful of similar traits showing in himself.

The patient married when he was 27, and the marriage has been successful. His wife describes the patient as quiet and reserved, fond of his cricket, and of stable mood. He has been a strict teetotaller, not because of any prejudice, but because he had been told drinking would influence his epilepsy adversely. He was religious, but not ostentatiously so, and indeed was not a particularly regular attendant at church. Apart from his cricket, he had few outside interests and spent his evenings at home.

His epilepsy appeared at the age of 17, and thereafter he had about five or six

fits each year. He was free from attacks for years before his marriage, but they returned subsequently. He had taken his condition seriously at all times and had taken bromides and barbiturates regularly at least for the last fifteen years. Two years ago his fits ceased and at about the same time he began to feel worried as to whether he had paid his debts. He would go into shops in the village and ask for confirmation that he had paid his bill of a week before, clearly aware that he had done so, but feeling impelled to confirm it. At first one confirmation would suffice, but later several visits might be necessary. At the same time he became fearful of leaving the gates of fields open, and despite the utmost care and repetition in closing a gate, would be tormented by the fear that the catch might have slipped, and he would sometimes return over several fields in order to confirm that the gate was secure. At night he worried lest a passing car should run over someone in the dark, and that the victim would be undiscovered until the morning. During one night he lay awake and on three occasions when he heard a car pass he got out of bed, dressed, and walked two hundred yards down the road looking for the body. His passage through the village was torment to him, for he had at least three separate compulsions to contend with. He had to go into every shop he passed and confirm that he owed no money there; he had to stop and kick every stone off the pavement lest someone should slip and be injured; and he had to pick up and examine any small piece of paper he saw lest someone might have lost something of value. Eventually his anxiety became intense and he felt unable to move out of doors and he was admitted to hospital. There he would ask repeatedly if he were entitled to the cigarettes and stamps with which he was issued, at the same time apologizing for his "stupid behaviour" and asking the nursing staff to be as tolerant of him as possible. When his temperature was taken he felt compelled to ask for confirmation that the thermometer had been properly removed and not allowed to slip down under his clothing. After washing his hands, which he did frequently, he returned repeatedly to be sure he had turned off the taps. He was troubled incessantly by rumination as to whether in a large hospital someone might be buried prematurely because a doctor was not available to confirm the fact of death.

No obsessional symptoms had ever occurred in his life before. He had been an orderly and tidy man, and somewhat "particular" but not to a degree which his family regarded as in any way abnormal. In hospital he was treated with sedatives—regular and slightly increased doses of barbiturates, and by simple psychotherapy. His anxiety disappeared and though not free of compulsions these were less and more in control at the time of discharge. In the short follow-up so far possible, he has remained static and with very little practical disability. Prefrontal leucotomy was considered, but deferred in view of his response to conservative treatment.

SUMMARY.

The combination recorded above may perhaps be more frequent than has been reported, though it is unlikely to be very frequent. It seems at least possible that a single pathology may be responsible for both manifestations, and that from some affected extrapyramidal area, a discharge may spread to both hemispheres, producing a generalized seizure. To speculate further would be profitless. It appears certain now that generalized convulsions may ensue from subcortical disease apart altogether from cortical involvement, as shown for example in Cappell and Dott's case; and it is equally certain that obsessional states are associated with ascertained disease of the brain-stem in its upper part. Certain other conditions, such as Gilles de la Tourette's disease, compulsive utterances and tics, and compulsive laughter might be regarded as sharing some of the features of both. It is possible, therefore, that there is a pathological entity which may produce this quite unusual combination of symptoms.

ACKNOWLEDGMENT.

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LEPTAZOL THERAPY IN MENTAL DISORDERS: A MODIFICATION USING SODIUM AMYTAL.

By P. MACDONALD TOW, M.B.,

Beit Research Fellow,

Research Department, Runwell Hospital, Wickford; recently Assistant Physician to the Hospital.

At a time when treatment by electrically induced convulsions is attaining a rapid and widespread popularity in clinical psychiatry, it is well to take stock of alternative methods. The purpose of this paper is to describe a method of modifying the treatment of mental disorders by leptazol (cardiazol, metrazol, phrenazol) so as to remove the unpleasantness hitherto associated with this treatment. Though leptazol therapy is still widely employed in psychiatry, its use has, for two reasons, become increasingly restricted. Firstly, it is very unpleasant for the patient; secondly, newer physical treatments, no less empirical, often yield better results in the conditions in which it was used.

In clinical practice it is probable that the first reason has so reduced its popularity that of recent years too little attention has been given to its relative therapeutic merits. If the treatment can be rendered acceptable to the patient, it becomes pertinent to ask if and when it is indicated. There are three possibilities:

- (1) Cases in which it is the treatment of choice.
- (2) Disorders which have recently failed to improve with other empirical methods, and which often do improve with a course of leptazol; or disorders in which the treatment of choice is contraindicated on coincidental grounds.
- (3) Miscellaneous circumstances, such as patients who refuse electrically produced convulsions; situations in which the apparatus for these is not available; or others mentioned below.

It has been advocated as the treatment of choice in catatonic stupors and certain schizophrenic reaction-types refusing food. It has been recommended in some hysterical syndromes with depressive features; in the excitement of mania; and in illnesses characterized by symptoms of self-depreciation and inferiority, or depression with expressed feelings of unworthiness or guilt. Many psychiatrists favour it in various affective disorders, opinions differing as to those in which it is most effective. I have found it very successful in an acute syndrome in young men, possibly seen more often during the war years. It superficially resembles early schizophrenia simplex, but the breakdown seems reactive rather than endogenous; it occurs in a personality previously healthy or perhaps rather inadequate, but not truly schizoid; and the subject

is dominated by ideas of inadequacy, hopelessness or uselessness in society, inferiority, self-depreciation, unworthiness or real guilt. It is the mental trend and content which is predominantly disturbed. Five of my cases were of this type and they responded well.

Other psychiatrists, though not accepting that it should be used first in the above conditions, will agree that in many of them it produces an improvement sufficiently often to make it indicated when other treatments have failed. This provides a large number of cases under Group 2.

Group 3, though not a psychiatric classification, is at the same time much less a matter of personal opinion and cases in this group are not uncommon. I have had two men who refused electrically produced convulsions and would have gone to any length to avoid them because they had seen the fits produced by the apparatus when patients were treated *en masse*. There are other patients who are horrified at being connected to mysterious electrical apparatus, but who fairly readily agree to an injection. Such patients would probably also object to leptazol injections if the usual unpleasant concomitants of these had to be endured ; but with the method below, they do not. Other patients in this group are those in whom it is important not to impair their memory ; and early schizophrenic reactions, encountered at the out-patient clinic, who will not, or cannot for domestic reasons, consent immediately to a long course of insulin therapy or any treatment necessitating hospitalization.

THE PROBLEM.

There are, then, in the present state of our knowledge, definite indications for leptazol therapy. If it could be made palatable to the patient it might be held much more in favour. Reasoning from the fact that in electrical convulsion therapy it is presumably the retrograde amnesia which renders it acceptable to most patients, I sought to produce such an amnesia in leptazol therapy, particularly for the terrifying experiences, cumulative in effect, which occur between the injection and the convulsion, experiences sometimes referred to as the aura. Starting with feelings of apprehension, strangeness or unreality, it progresses to sensations of choking, buzzing and tingling ; unpleasant olfactory, gustatory or vivid visual hallucinations ; fantasy formations ; and, finally, stark terror. The intense struggling and pleading exhibited to avoid this are familiar phenomena. Cook has stated the problem in a paper in which he discusses the role of fear in leptazol convulsion therapy. He remarks that even partial amnesia helps to allay subsequent apprehension, and that a complete amnesia, sufficiently retrograde to include the preparatory phases, should go far to remove one of the greatest drawbacks of the therapy. I feel certain that the whole objection to treatment is due to fear of the aura period, and other writers entirely agree with this. Attempts have been made to dull the patient's perception of the aura by hyoscine hydrobromide, or paraldehyde premedication, induction of insulin hypoglycaemia, administration of nitrous oxide to the point of asphyxia—all of course before the injection of leptazol.

I have experimented with soluble hexobarbitone prior to the leptazol, the aim being to inject this slowly until the patient is practically unconscious ; to

wait until he has partly revived ; and then to inject the leptazol. Briefly, as hexobarbitone is antagonistic to leptazol, it is not practicable to choose a dose which is large enough effectively to narcotize the subject and yet not large enough to impair the action of leptazol. A small dose of soluble hexobarbitone merely dulls the patient's perception, so that his memories are rather less vivid, but still present ; and I abandoned the idea of prior administration of this or any other drug.

TECHNIQUE.

The method I have adopted is to follow the leptazol convulsion by an intravenous injection of sodium amytal so as to keep the patient fairly deeply unconscious after the convulsion ; and in such amount that he remains unconscious for a further half to one hour. There are three simple points to observe :

(1) The time of injection : the sodium amytal is injected immediately respiration becomes regular.

(2) The site of injection : the vein to be used should be selected and prepared before giving the leptazol.

(3) The amount at first injection : it is important to avoid subconvulsive doses of leptazol.

The sodium amytal is not injected immediately after the convulsion, but as soon as respiration becomes regular, usually about 20 seconds later. I have considered it unwise to give an intravenous barbiturate like sodium amytal while respiration is disordered ; but there must be no delay when it recovers, for I have found that, if there is, the retrograde amnesia is less complete. Similarly, a subconvulsive dose of leptazol should be avoided, for whether this is followed by a larger dose in order to produce a convulsion, or by the sodium amytal when it becomes apparent that no convulsion will occur, then, in either case the sequence of convulsion—immediate deep coma—light coma, is broken, and there is less likelihood of success. With the sodium amytal the restlessness or struggling which often occur in the minutes soon after the convulsion are completely avoided. After this restlessness the patient does often sleep for a while ; but with the sodium amytal the sequence is altered, and the deepest unconsciousness follows the convulsion.

Pre-selection of the site becomes important in patients with bad veins, and in them it may be vital. In such subjects, if only one inadequate vein is found, it is often spoiled by the leptazol and delay in searching for another after the convulsion may lead to failure of the technique. For similar reasons I have a spare syringe already filled with sodium amytal. I also have at hand a syringe of soluble hexobarbitone ready to inject in cases where a convulsion is not produced. I chose this drug for this purpose because it is more rapid and the amount necessary to get the patient fairly deep is easily judged while the injection is made.

As to the choice of barbiturate for the standard technique, the criterion is that it has the appropriate rapidity of action and of clearance. I have no grounds for believing there can be anything specific about sodium amytal. It has the desirable initial action, and a rate of clearance which from one treatment to the next allows judgment of a dose which will secure the right period of

unconsciousness. The method has been used on out-patients, where it is convenient to have control over the length of unconsciousness.

The dose is adjusted from session to session. After the first injection of leptazol, in a normal adult I used 0.35 gm. sodium amytal. If the patient remained unconscious for much over an hour I reduced it to 0.2 gm. next time. If he could be roused after only a few minutes, I increased the dose next time, up to 0.4 gm. or 0.5 gm. I tended to use a large dose at the first session, as I did also with leptazol, and later to reduce it, rather than the reverse. In this technique, initial success contributes largely to success over the whole course. In two patients who were difficult to rouse after only 0.15 gm. sodium amytal at the third session, I substituted 0.2 gm. soluble hexobarbitone at the fourth session and adjusted this at subsequent sessions to get the desired result.

FURTHER MODIFICATION.

I may mention here a recent further modification with an intravenous barbiturate, not before each leptazol injection, but before the whole course of treatment. At the first session the patient is prepared exactly as he will be at subsequent sessions. He is told he is to have an injection which will make him lose consciousness, and as this suggestion is being made he is given 0.4 gm. soluble hexobarbitone intravenously, or a little more if necessary, and allowed to lie until he wakes. At the second attendance he is given 6 to 7 c.c. of "Injection of Leptazol" and is reminded that he will rapidly lose consciousness; this is followed up by sodium amytal and the course continued as above. I have found the suggestive reinforcement of the first "treatment" is effective, and by the third session the patient is accustomed to the procedure and content in the belief that he is having some sort of sleep therapy. I think this further refinement will give optimum effectiveness to the whole technique.

RESULTS.

In all, 34 in-patients and 16 out-patients were treated and I will discuss them in three groups:

	Group 1.	Group 2.	Group 3.	Total.
In-patients . . .	4	22	8	34
Out-patients . . .	6	9	1	16

The first group, 4 in-patients and 6 out-patients, had what can be called an amnesia for treatment. By this I mean a retrograde amnesia comparable with that obtaining in a patient having electrical convulsion therapy who cannot remember the nature of the previous treatment. It does not imply amnesia for the entire procedure of coming up and having treatment.

In the second group, of 22 in-patients and 9 out-patients, there was amnesia for leptazol symptoms. Though the patient remembered his preparation and the injection itself, he did not remember what followed the injection or did not associate it with anything unpleasant.

The third group had a partial amnesia. They remembered enough of the unpleasantness of the leptazol symptoms to make them dislike further treat-

ment ; but they certainly did not suffer the extreme fear which results from leptazol by itself, and only persuasion was necessary to induce them to continue. Relatively more in-patients were placed in this group because a few could not be regarded as perfectly reliable witnesses ; and if there was any doubt they were placed in this group rather than the one above. There was one in-patient in whom we could not be sure that the technique had made any difference.

In no case was there any trace of the restlessness and excitement which sometimes occurs after treatment with unmodified leptazol. Even in Group 3 there were no signs of any of the reactions which may occur in patients recovering from a leptazol convulsion.

The patients were seen after treatment by another member of the medical staff, and we have judged the results from the descriptions and introspection of the patients, on the one hand, and from their reactions to the treatment and to the prospect of more, on the other. Of great assistance was the fact that twelve in-patients had had a previous course of electrical convulsion therapy and four a course of unmodified leptazol ; while eight out-patients had had a previous course of electrical convulsion therapy. This provided the background with a measure by which to assess the effectiveness of the present technique. Some patients preferred the course of injections to electrical treatment. In most cases the same sister or charge nurse assisted at both courses and considerable weight was given to their opinion on the reactions of the patients, and especially on what the patients told them about it in the absence of the doctor. In fact, up to the third treatment of each course, I judged the results largely on detailed information obtained from a reliable nurse.

DISCUSSION.

Interesting points emerge from consideration of the patients who actually preferred this treatment to treatment by electrically produced convulsions. I am sure that the preference does not result from an amnesia which in every case was better than that obtaining in electrical convulsion therapy in the average patient. Other factors must be responsible. Now many patients, especially if unaccustomed to the hospital atmosphere or to complicated apparatus, are frightened by the arrangement for electrical convulsion therapy and by the way in which they are prepared for it. If then in leptazol therapy an amnesia can be produced comparable with that in electrical convulsion therapy, so that the patient comes to each individual treatment with the same preconception of it, it is not surprising that many will prefer the more familiar procedure of injection to that of having their head scrubbed, tightly strapped and connected to elaborate electrical equipment. Patients, of all grades of intelligence, know that there is something more in the " electrical treatment " than they have been told.

I suggest that the technique does not necessarily result in a retrograde amnesia as good as that in electrical convulsion therapy ; but it does result in one which removes the unpleasant concomitants of leptazol injections. From the figures above it can be seen that 20 per cent. of subjects had an amnesia as good as, or better than, that obtaining with the electrical method. However,

a further 62 per cent., making a total of 82 per cent., could not associate the treatment with any unpleasant sensations. This is all that was aimed at, but the end-results, for reasons advanced above, are better than anticipated. In the remaining cases the aura phase was reduced by varying amounts. Whatever the mechanism, the treatment is rendered acceptable to most patients.

Further, there is more perfect control, from session to session, in a method involving injections of known amounts of a standard solution. In the electrical method, any one voltage and time setting may not produce the result expected by reference to the previous session; and most clinicians are familiar with the growing apprehension of the patient while technical adjustments are being made.

It is also likely that this modification will lead to better therapeutic results. It has been shown by Cohen, for example, that a large element of fear in leptazol therapy considerably reduces its curative effect; and this technique should enhance the therapeutic value of the method.

SUMMARY.

There are several indications in psychiatry for leptazol therapy, but it has fallen out of favour largely because of its very unpleasant concomitants. A method of overcoming these is described, and its results in a series of in-patients and of out-patients are discussed.

This work was carried out at Runwell Hospital, Wickford, and I have pleasure in thanking Dr. Ström-Olsen, Physician Superintendent for his help throughout.

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Part II.—Reviews.

Shock Treatment. By L. B. KALINOWSKY and P. H. HOCH. London : William Heineman, 1946. Pp. xiv + 294. Price 21s.

After some account of the historical development of shock treatment the author deals with insulin shock, convulsive shock, combined insulin-convulsive shock, other somatic non-surgical treatments and prefrontal lobotomy in that order. He gives a good account of insulin shock treatment, including its various modifications. He wisely points out that subcoma doses of insulin should not replace insulin shock in the treatment of the psychoses. He quite agrees with Sargant and Slater in their views on its value in treating psychoneurotic patients, particularly in anxiety states, to make the patient more amenable to psychotherapy.

In discussing E.C.T. he quotes Sogliani as having given as many as five convulsions in from ten to twenty minutes. He gives this intensive treatment to all who fail to recover with the usual treatment. They are most valuable in acutely disturbed patients threatened by the danger of exhaustion.

In discussing prefrontal lobotomy the author quotes Fiamberta as operating through the orbita into the skull. He points out the importance of psychological treatment, post-operative treatment, and that readaptation may take months or years, and then curiously enough says that a decision as to the outcome of an individual case should not be made less than several *months* later. In our experience it is wise to wait five years before giving any hard and fast opinion.

The value of lobotomy in the treatment of psychoneuroses is emphasized, especially as E.C.T. is of little use in these conditions. We should have liked to have seen some mention of the use of lobotomy in the treatment of intractable pain, Freeman and Watts having published some work on this aspect.

The book is very well worth reading and has a good bibliography.

G. W. T. H. FLEMING.

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The Genetic Theory of Schizophrenia.

1. The methods available for genetic investigations in man are the pedigree or family history method, the contingency method of statistical prediction, and the twin study method.

2. A study of the relative effects of hereditary and environmental factors in the development and outcome of schizophrenia was undertaken by means of the "Twin Family Method." The study was organized with the co-operation of all mental hospitals under the supervision of the New York State Department of Mental Hygiene. The total number of schizophrenic twin index cases, whose co-twins were available for examination at the age of fifteen years, was 794.

3. In addition to 1,382 twins, the 691 twin index families used for statistical analysis include 2,741 full siblings, 134 half-siblings, 74 step-siblings, 1,191 parents, and 254 marriage partners of twin patients. The random sampling of these twin index pairs is indicated by the distribution of 174 monozygotic and 517 dizygotic pairs, yielding a ratio of about 1 : 3.

4. The morbidity rates obtained with the "Abridged Weinberg Method" are in line with the genetic theory of schizophrenia. They amount to 1.8 per cent. for the step-siblings, 2.1 per cent. for the marriage partners, 7.0 per cent. for the half-siblings, 9.2 per cent. for the parents, 14.3 per cent. for the full siblings, 14.7 per cent. for the dizygotic co-twins, and 85.8 per cent. for the monozygotic co-twins. This morbidity distribution indicates that the chance of developing schizophrenia in comparable environments increases in proportion to the degree of blood relationship to a schizophrenic index case.

5. The differences in morbidity among the various sibship groups of the index families cannot be explained by a simple correlation between closeness of blood relationship and increasing similarity in environment. The morbidity rates for opposite-sexed and same-sexed two-egg twin partners vary only from 10.3 to 17.6 per cent., and those for non-separated and separated one-egg twin partners from 77.6 to 91.5 per cent. The difference in morbidity between dizygotic and monozygotic co-twins approximates the ratio of 1 : 6. An analysis of common environmental factors before and after birth excludes the possibility of explaining this difference on non-genetic grounds.

6. The difference between dizygotic and monozygotic co-twins increases to a ratio of 1 : 55, if the similarities in the course and outcome of schizophrenia are taken as additional criteria of comparison. This finding indicates that constitutional inability to resist the progression of a schizophrenic psychosis is determined by a genetic mechanism which seems to be non-specific and multifactorial.

7. The predisposition to schizophrenia, that is, the ability to respond to certain stimuli with a schizophrenic type of reaction, depends on the presence of a specific genetic factor which is probably recessive and autosomal.

8. The genetic theory of schizophrenia does not invalidate any psychological theories of a descriptive or analytical nature. It is equally compatible with the psychiatric concept that schizophrenia can be prevented as well as cured.

(Author's abstr.)

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The Genetics of Epilepsy.

Study of the incidence of epilepsy among 12,119 of the near relatives of 2,130 epileptics and among 55 twin pairs affected by seizures, together with analysis of the brain wave records of 470 relatives and of the 55 twins, leads to the conclusion that epilepsy *per se* is not inherited but a tendency or predisposition usually is inherited. The terms, genetic and acquired epilepsy, should replace the meaningless conventional terms essential and symptomatic. Probably in most patients both genetic and acquired factors are present. The incidence of epilepsy is higher among the near relatives of epileptics if pathology of the brain did not antedate the onset of seizures, if the patient's epilepsy began early in life, if he was mentally abnormal at birth, if he has *petit mal* and if the patient is female.

The electroencephalogram is an hereditary trait and brain wave tracings, properly made and interpreted, may be of positive value in visualizing a transmitted quality which (with the possible help of acquired pathology or pathophysiology) may eventuate in epilepsy. The practical value of this evidence is limited, because cortical electrical activity is a fluid trait, dysrhythmia cannot always be demonstrated in patients, and tracings of relatives may display only minor deviations from normal. Therefore, negative electroencephalographic evidence may not be significant.

(Author's abstr.)

Dilantin Treatment for Behavior Problem Children with Abnormal Electroencephalograms.

A group of behavior problem children with abnormal electroencephalographic findings were treated with dilantin.

None of the children presented clinical evidence of epilepsy or were known relatives of epileptics. The physical and neurological examination of all the children was negative. None of the patients were adequately controlled by their environment previous to treatment. All were treated on an outpatient basis and showed definite clinical improvement under dilantin treatment.

The results are considered encouraging and warrant further follow-up and study.

The implications and significance of recognition and treatment of these cases in terms of prevention or amelioration of adult neuropsychiatric difficulties are discussed. (Authors' abstr.)

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- Some Common Features of Concrete and Abstract Thinking. *Helson, H., and Helson, H. B.* 468

Intellectual Functions with Restricted Intakes of B-complex Vitamins.

The chemical, physiological and psychological consequences of varying the intake of the vitamin B-complex on 8 physically normal men (*C. A.*, 20-32) were determined. Following a standardization period of 41 days, they received a diet in which thiamine, riboflavin and niacin were partially restricted for 161 days. Immediately following this, Ss were acutely deprived of these vitamins for 23 days and then received a supplementation of thiamine alone for 10 days. Two general intelligence tests (the ACE and the Ohio State University), the Porteus Maze, Cattell's Cursive Miniature Situations, and various more specific tests (spatial relations, verbal fluency, perceptual speed, number facility, etc.) were used. The tests were given in such a way as to trace the changes in intellectual performance throughout the period of deprivation. The results showed that acute deprivation of the vitamin B-complex resulted in a limited deterioration of performance on the tests demanding speed. Rate of learning was not affected though the level of performance was lowered. Recovery was produced by thiamine supplementation during 10 days. Psychoneurotic scores, especially the depression scale (Minnesota Multiphasic), rose during the period. The significance of these data in relation to other studies is considered.

D. E. JOHANSEN (Chem. Abstr.).

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*Cerebral Dysrhythmia and Psychopathic Personalities: A Study of Ninety-six Con-
 secutive Cases in a Military Hospital.*

Electroencephalographic tracings were obtained from 96 of a series of 104 patients with a disorder diagnosed as constitutional psychopathic state in a military setting. Within the special situation from which the patients were obtained, the sample was unselected. The personalities were evaluated first by psychiatric criteria, so that the finding of electroencephalographic abnormality did not influence diagnostic judgment. The records were classified in accordance with the Gibbs' criteria with the single exception that records showing certain slow dysrhythmias of paroxysmal character were classified with records of paroxysmal activity rather than with those containing slow sequences. The percentage of abnormal records did not greatly exceed the reported incidence of abnormality in normal control groups studied by different investigators, although we did obtain a definitely higher percentage of records with F-2 and S-2 frequencies than has been obtained for normal controls. The authors find no relationship between the severity of different manifestations of psychopathy and the incidence of abnormality in records.
 (Authors' abstr.)

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Results of Treatment of Multiple Sclerosis with Dicoumarin.

The evidence that sclerotic plaques arise as a result of venular thrombosis is reviewed.

The results of the treatment of 43 patients with multiple sclerosis with dicoumarin (3,3'-methylene-bis-(4-hydroxycoumarin)) for periods varying from six months to four years is reported.

Doses of dicoumarin sufficient to raise the prothrombin time to thirty seconds continuously were administered, with constant laboratory control.

Twenty-five patients suffering from a remittent form of the disease were adequately treated without interruption for a total period of approximately sixty-one patient years. In this group no fresh symptoms or obvious acute outbreaks occurred. Most of the 16 patients with chronic progressive disease continued in their downward course.

The treatment of two patients was interrupted for one reason or another. The patients were free from new symptoms while taking treatment, but both had acute relapses when it was discontinued. In two patients large doses of dicoumarin failed to produce the expected increase in prothrombin time, and relapses occurred.

(Authors' abstr.)

The Electroencephalogram and Personality Organization in the Obsessive-compulsive Reactions.

The number of patients in this series was relatively small, but since each was thoroughly studied for an adequate period it is felt that certain tentative conclusions may be drawn:

(1) Pathologic findings were present in the electroencephalograms of 13 out of 24 patients who presented obsessive-compulsive symptoms. There did not appear to be a connection between any special type of compulsive psychopathic disorder and the abnormal electroencephalographic findings. There was, however, a high degree of correlation between disturbances of the underlying personality organization and electroencephalographic abnormalities. All the patients with clearcut disturbances of personality organization, i.e. with psychopathic personalities, had abnormal electroencephalograms. Ten of the 11 patients who were considered to be well organized persons had normal electroencephalograms.

(2) Abnormal electroencephalograms, which were found in all the patients with disturbances of personality organization, were characterized by the presence of excessive quantities of slow waves (3 to 7 per second). The consistent finding of slow activity in this series suggests that we are dealing with the same type of neurophysiologic disturbance observed by Simons and Diethelm, who, in their study of psychopathic personalities, reported:

"The majority of abnormal records were those containing sufficient 5 to 7 a second activity of low average amplitude in the frontal and parietal leads to be considered beyond the limits of normal."

(3) If the conclusions drawn from these observations are valid, certain therapeutic implications follow. Any patient who shows electroencephalographic abnormalities of the type presented by these poorly organized psychopathic patients must be suspected at least of having a deficiency in the synthesizing functions of his personality; this point should be investigated further, utilizing both clinical observation and anamnestic data from outside sources whenever possible. In the treatment of a psychopathic patient with obsessive-compulsive symptoms, it has been our experience that more or less passive analytic technics will result in the disappearance of the obsessive-compulsive phenomena, but there remain the manifestations of psychopathic personality, which must be approached with a more active, synthesizing type of treatment. The electroencephalogram is a useful tool in giving an early lead to the presence of disturbances of personality organization, for these disturbances are not always obvious during early contacts with the patient.

(4) The present study gives evidence that certain types of psychopathic personality, described by Simons and Diethelm, are associated with electroencephalographic abnormalities, whether these disturbances of personality organization appear as the leading clinical features or occur in cases in which obsessive-compulsive symptoms dominate the clinical picture. (Authors' abstr.)

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Effects of Pitressin Hydration on the Electroencephalogram; Paroxysmal Slow Activity in Non-epileptic Patients with Previous Drug Addiction.

The electroencephalograms of fourteen non-epileptic men with previous drug addiction were studied before and after pitressin hydration. No clinical seizures were induced by this procedure.

The alpha frequency showed a tendency to slowing after hydration, but in only three instances was the degree of change greater than that which could be expected from day to day variation. There was no significant change in the percentage of alpha activity.

In half the records there was shift to the slow side of the frequency spectrum.

In half the records paroxysmal slow activity of moderately high amplitude appeared after hydration.

There was some correlation between the appearance of paroxysmal slow activity and the shift of the frequency spectrum to the slow side, but no correlation with the degree of hydration or the amount of pitressin administered.

The possible significance of these observations in their relation to idiopathic epilepsy is discussed. (Author's abstr.)

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Prefrontal Leucotomy.

The author emphasizes the rate of 14 per cent. of recoveries and 6 per cent. of great improvements as the result of leucotomy, notwithstanding the poor condition of the material. Simple leucotomy quiets and produces other minor changes in behavior without any alteration in the structure of the psychosis are not considered. An easy, inexpensive and nearly dangerless method of treatment, leucotomy is doubtless able to improve the conditions of the chronic patients. This was one of the reasons that induced the author to carry out the psychosurgical method of treatment. (Author's abstr.)

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Fibre Connections of the Subthalamic Region and the Centro-median Nucleus of the Thalamus.

Lesions have been made in the subthalamic region of the brain in five Macaque monkeys. The subthalamic nucleus is shown to project:

- (1) On to the external and internal division of *Globus pallidus*.
- (2) On to ipsilateral and contralateral red nucleus.
- (3) On to ipsilateral and contralateral thalamus.
- (4) On to a nucleus dorso-medial to substantia nigra.

The substantia nigra projects:

- (1) On to the *Globus pallidus*.
- (2) On to the centro-median nucleus.
- (3) On to the anterior colliculus.

A pathway from the centro-median nucleus and the dorso-medial nucleus of the thalamus to the central grey passing through the subthalamic region has been demonstrated.
(Authors' abstr.)

Nutritional Neuropathies in the Civilian Internment Camp, Hong Kong, January, 1942-August, 1945.

Four diseases affecting the nervous system, and apparently due to dietary deficiency, are described as they occurred in the Civilian Internment Camp, Hong Kong, 1942 to 1945.

(1) Subacute wet beriberi—844 cases, conformed to previous descriptions and, in respect of incidence, prevention and treatment, was apparently due to a pure vitamin B₁ deficiency. The threshold vitamin B₁-carbohydrate ratio was found to be about 0.4 mgm. per 1,000 carbohydrate calories.

(2) Chronic dry beriberi—small number of typical cases responded slowly to treatment with vitamin B₁, but more rapidly to whole vitamin B complex.

(3) "Burning feet" syndrome—756 cases, in 35 per cent. of which dry beriberi was superimposed, were found to show no response to vitamin B₁ or nicotinic acid, but to be slowly cured by food rich in vitamin B complex, the individual factor responsible being probably pantothenic acid.

(4) Amblyopia—370 cases, in which central or paracentral scotoma was the outstanding feature, was generally associated with B complex deficiencies and showed some response to foods rich in these factors, though on the present evidence the causative deficiency might equally be of an essential amino-acid.

(Author's abstr.)

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The Problem of Disseminated Sclerosis.

The conclusions reached in this paper may be briefly summarized as follows: The cause of disseminated sclerosis remains unknown, but it would seem to lie either in the direction of a biochemical or enzyme abnormality, of which proof is so far lacking, or on the other hand a toxi-infective process. Our increasing knowledge of the various forms of encephalitis and encephomyelitis in man and the lower animals, and the part played by viruses in certain of them when viewed against the histological background of disseminated sclerosis suggests that this disease is also infective in origin. The results of the clinical approach bring to light no facts which are contrary to this view and some which seem to favour it. The view is put forward that the course of the disease is determined by an immune reaction to an infection, and that the extent of this reaction varies considerably from case to case. The familial incidence of the disease is significant and suggests that an inherited constitutional factor may render an individual more susceptible to it. Pregnancy, trauma and mental stress may, in individual cases, precipitate the disease or may be closely associated with a relapse. These facts are not inconsistent with the theory of an infection, but at the same time a further study of such cases is desirable in order to understand the manner in which symptoms are produced. With the exception of cases in which there are "influenzal" symptoms, the onset of the disease is not generally accompanied or preceded by constitutional symptoms. Thus the possibility arises that invasion of the nervous system and the appearance of the first sign of the disease may not always coincide in time, but that the former may take place months or years previously as in rabies and syphilis. If this premise be admitted, then the question arises at what point in the patient's

life history did the nervous system become infected or sensitized? In the investigation of a series of 142 cases no single common factor could be found which provided an answer to this question, although the scope of the enquiry may not have been sufficiently wide. Attention was next turned to the portal of entry of the hypothetical agent or toxin, and by analogy with other infections of the nervous system, it was inferred that the skin and the alimentary tract were the likeliest starting points of the invader. Furthermore, from the author's knowledge of the histology of disseminated sclerosis it was necessary to postulate a haematogenous spread from the focus with or without additional local spread by cranial or peripheral nerve pathways.

In a number of cases in this series the clinical onset of the disease was preceded at varying intervals by an infective focus of the skin or subcutaneous tissue. In certain of these cases local pain and swelling persisted, suggesting the presence of a chronic inflammatory process. The fact that the first sign of disseminated sclerosis sometimes occurred at a segmental level roughly corresponding to the infected limb suggests that this sequence of events was no mere coincidence. It is fully realized that the evidence in favour of the skin as an occasional portal of entry in disseminated sclerosis is purely circumstantial, but it seems to warrant further consideration in view of the part played by the skin in other infections of the nervous system. On theoretical grounds the possibility of other foci of infection playing a similar role must be borne in mind. The remaining portal of entry to be considered is the alimentary tract. I have already referred to a small group of cases in which influenzal symptoms immediately preceded the onset of the disease, thus suggesting the throat as a point of entry. The fact that a history of intestinal disorder prior to the onset of the disease is rarely obtained in these patients should not exclude the intestinal tract from consideration in any further research. Finally, the author wishes to make it clear that in the majority of patients included in this investigation no clue could be obtained as to how the disease originated.

(Author's abstr.)

Traumatic Amnesia.

It is naturally important to discuss the significance of the phenomena described above in so far as they may throw light on cerebral mechanisms. In the first place it is clear that traumatic loss of consciousness prevents remembering, and that this inability to remember events persists in most cases until full consciousness has returned. In other words, the recovery of continuous remembering coincides with a late, if not a last, stage in recovering consciousness.

It may also be affirmed that a single blow of varying severity can disturb remembering, as it does consciousness, for very varying periods of time, and that the duration of this period depends usually on the severity of the initial neuronal commotion.

The almost constant occurrence of R.A. indicates that the injury, though it cannot have time to prevent what is last seen or heard from reaching the sensorium, does completely prevent its retention for future recall. The latter process presumably requires a few seconds of time for completion.

The occasional occurrence of a vision of events within the R.A. indicates that in these cases some form of registration has occurred with great vividness which, though it can never be properly retained for later recall, can reproduce itself from a relatively low level in the form of a momentary "vision." This appears to be a striking illustration of different levels of activity in the Hughlings Jackson sense. The injury in such a case appears to have blocked the process of retention halfway.

The variations in the R.A. during recovery of full consciousness seem to be specially significant. Distant memories return first and loss of memories for the previous few years may, for a time, be so complete that the patient believes himself to be several years younger. After severe injuries there may be a permanent R.A. of several days' duration, which may include events of great importance to the patient.

General brain trauma, therefore, has an effect on *recent* memory, which is much greater than its effect on remote memory, and this fact must be closely linked with the physiology of remembering. It is clear that the events forgotten are often of importance to the individual, yet for a time, and sometimes permanently, they are completely erased, while distant memories of little importance are returning freely.

The recovery of this type of memory loss is by shrinkage towards the present time. The long amnesic period recovers not so much according to the relative importance of events occurred. There is thus a vulnerability of memories which depends directly on their nearness to the injury.

The authors are thus forced to the conclusion that as memories become older they become more strongly established irrespective of their importance to the individual, while recent memories are relatively liable to traumatic extinction, however important they may be.

Further, it is clear that a long R.A. is almost always associated with a long P.T.A. The authors have good evidence that a long P.T.A. usually means a very severe injury, hence a long R.A. is observed when severe general neuronal commotion has occurred. It can thus be concluded that a long R.A., whether temporary or permanent, occurs after severe neuronal commotion and that severe neuronal commotion has a much more damaging effect on erasing recent than remote memories.

In the cases with long R.A. which recover spontaneously, it is evident that the effect of this neuronal commotion is reversible, but in some cases the effect is permanent.

In either case the observation demands a physiological explanation. It seems likely that memory of events is not a static process. If it were, then distant memories would surely fade gradually and would be the more vulnerable to the effects of injury. On the contrary, when the brain is injured, these distant memories are the least vulnerable. It seems that the mere existence of the brain as a functioning organ must strengthen the roots of distant memories. The normal activity of the brain must steadily strengthen distant memories, so that with the passage of time these become less vulnerable to the effects of head injury.

The patient with senile dementia may show a very similar loss of recent memory. She may forget the visit of her favourite grandchild within twenty minutes, yet she remembers an unimportant escapade of fifty years before in every detail. The distant memory shows no sign of fading and this suggests that it has received continual reinforcement and has survived not because it was important, but because the brain throughout the decades has strengthened it automatically till it has become highly resistant to cerebral degeneration.

It is tempting to speculate on the possible physiological processes concerned in remembering which could behave in this way. The brain works through chains and circuits of neurones which can set a pattern for automatic responses of infinite variety. Presumably the synapses of such a chain pattern are "opened" to allow the least possible delay and to avoid diversions in other directions. The neuronal system concerned with a certain memory, if it is to behave with the passing of years in the way it does, must then be automatically strengthened or more strongly canalized by the normal activity of the brain, and perhaps indeed this facilitation of the circuit is carried out by the spontaneous rhythm of the neurones concerned.

The recall under barbiturate hypnosis, or occasionally in the state of traumatic confusion, of events which cannot be remembered in the normal state of consciousness is of considerable interest. It seems as if under certain conditions clinically manifest as clouded consciousness, and physiologically determined by impairment of function at Jackson's highest level, pathological recall may occur as a release phenomenon. The twilight states of dreaming and toxic or infective delirium are analogous, and in these also there may be recall of experience not available in the state of clear consciousness.

(Authors' abstr.)

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A Comparative Study of the Level of Aspiration of Normal and of Neurotic Persons.

1. Level of aspiration tests were given to 20 normal men and 33 normal women and to 100 male and 32 female neurotic service patients.

Estimates of future performance (goal discrepancy scores), estimates of past performance (judgment discrepancy scores), responsiveness in the setting of goals to changes in the level of performance (index of flexibility), and the percentage of typical reactions to success and failure were calculated.

2. All four groups overestimated future performance and underestimated past performance.

3. The behaviour of the women differed from that of the men in three respects. They had (a) a significantly lower average goal discrepancy score, (b) a significantly lower average judgment discrepancy score, and (c) a significantly higher index of flexibility.

This sex difference applied to the normal and the neurotic groups.

4. Significant differences were found in the responses of normal and neurotic subjects. The neurotic women had a higher positive goal discrepancy score than the normal women. Normal subjects tended to underestimate their past performance more than neurotic subjects. The spread of scores of the neurotic groups was significantly larger than that of the normal groups. The distribution of the scores of the neurotics was bimodal.

5. A different patterning of the responses was obtained for neurotics in contrast to normals. The correlation between goal and judgment discrepancy was positive for the normal and negative for the neurotic groups. The correlation between judgment discrepancy scores and index of typical reactions was negative for the normal and positive for the neurotic groups.

6. A new code symbol substitution test was used to measure the level of aspiration responses of 29 male and 29 female hysterical patients and of 34 male and 35 female dysthymic patients. The hysterics were found to have a more "realistic" objective goal-setting behaviour than either the normal or the dysthymic subjects. The goal judgment discrepancy scores of the hysterics were small and their indices of flexibility high. The dysthymics showed wide deviations in their estimates of past and future performance from actual performance. Their indices of flexibility were low.

7. Increased motivation was obtained by offering incentives. A comparative study of the behaviour of 20 male hysterical and 22 male dysthymic patients under these conditions was carried out. The increase in ego-involvement led to an accentuation of the response pattern that had been found to be characteristic of these two reaction types.

(Author's abstr.)

The Recalling of Thoughts.

The foregoing study is a contribution to the discussion of the old problem: Can we think without images? The problem is approached by considering the process of recalling thoughts. The word "thought" means here a mental content.

1. Introspection shows that there is no direct recall of a thought separated from its verbal expression or any other sensuous support. Contradictory observations seem to confuse the recalling of the thought itself with the direction of the mind towards a previous thought with the help of indicative images.

2. We often forget the original wording when we recall thoughts and replace it by new expressions of similar meaning. In order to explain this fact it is by no means necessary to assume that memory-traces of thought contents can be separated from any traces of words. A much better explanation is provided by the assumption that the traces of thoughts remain in close connection with those of words, and form a unity with them which may be changed with regard to the words or to the thoughts or to both.

3. An interesting problem concerning the dependence of thought upon its verbal expression arises when we ask whether the retention of thoughts is influenced by the way in which they are expressed. A method is indicated which enables us to compare the retention of thoughts which are expressed in the mother tongue of the observer with the retention of those which are expressed in a foreign language. This method was applied to three observers (one of them bilingual) and the results were analysed as a first approach to this problem. Further investigations with bilingual individuals might give us an answer to that problem and provide a new argument for or against the existence of imageless thoughts. (Author's abstr.)

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Differential Modification of Post-rotational Nystagmus of Pigeons with Cerebral Lesions.

Two main experimental groups with cerebral lesions were tested for habituation (decreasing duration) of post-rotational nystagmus, one group with and the other without habituation training prior to the operation. Various control groups were also used. Cerebral lesions decreased significantly the usual habituation effects. In animals not previously habituated, the correlation between the size of the cerebral lesion and the degree of habituation was $-.65 \pm .129$. Pigeons habituated before the operation showed a greater duration of nystagmus than did normal controls, but animals with the skull trephined and no cerebral operation showed the same modification of nystagmus as the birds with lesions. The results are interpreted as favoring a central theory of habituation, but not a learning theory. Data are summarized which favor the concept that habituation of nystagmus is an homeostatic phenomenon. "The mechanism involved in throwing the homeostatic state out of equilibrium, thus producing nystagmus, involves a pattern of ratios between the neural discharge of the stimulated labyrinthine receptors. Continued stimulation of the non-acoustic labyrinth causes a new level of integration to be reached between the impulses of the eighth nerve and the nervous system."

N. L. MUNN (Psychol. Abstr.).

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The Nuclei of the Human Thalamus: A Comparative Approach.

(1) The cell groups of the rat and monkey thalamus were studied to serve as a background for a comparative approach to the human thalamus. The cell groups of the human thalamus were studied, and a wax model of these nuclei made.

(2) A comparative study of previous investigators' work is discussed.

(3) The nuclei of the rat, monkey and human thalamus are compared in chart form as to terminology and subdivisions.

(4) The nucleus medialis, nucleus ventralis lateralis, and pulvinar are believed to increase in size, due to their connection with the increasing frontal area, cerebellum, and inferior parietal and occipital associational areas respectively.

(5) The divisions of the medial thalamus remain fairly constant in phylogeny in contrast to the very rapidly developing lateral thalamus due to the great elaboration of the associational areas of the cerebrum. The divisions of the lateral thalamus of man are difficult to homologize with lower forms since the changes from one form to the next are complex. (Authors' abstr.)

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Retrograde Degeneration of the Thalamus Following Prefrontal Lobotomy.

On the basis of 1 successful and 3 unsuccessful cases of prefrontal lobotomy among the 12 studied at necropsy the conclusion is reached that because of the point-to-point correspondence of cortex and thalamus it is possible to designate areas in the thalamic nuclei that correspond with cortical cytoarchitectonic areas. The central part of the medial nucleus projects to the frontal pole, the lateral portion to the convexity, the medial portion to the base. The anterior nucleus projects to the medial surface of the hemisphere. The lateral group of nuclei projects to the motor and premotor areas and to the frontal adversive field.

(Authors' abstr.)

Extracortical Connections of the Primate Frontal Cerebral Cortex. (I) Thalamo-cortical Connections.

The thalamofugal connections to the frontal cortex of the monkey have been restudied and a series of maps of the primate thalamus (in terms of the Brodmann nomenclature) have been prepared. Comparison of these maps with the projections of the human thalamus, as reported by Freeman and Watts ('47), indicates that the basic principles of projection are the same for both primates. The relation of the cortical plan of the human to that of the monkey is similar to that between a fully and a partially opened oriental hand fan. The basic arrangements and relative positions of the elements present in the simian, persist in the human, but there is a separation and interposition of additional material between these basic elements, both in the cortex and thalamus. The separation of elements and addition of new material in the thalamus is much less apparent than in the cortex.

There are three discrepancies between the communication of Freeman and Watts ('47) and the present. The first is that cortex designated as area 8 by Brodmann in the monkey is found by the author to project upon the dorsolateral part of the medial nuclear group, while that designated as 8 by Brodmann in the human is found by Freeman and Watts to project upon the dorsomedial part of the lateral nuclear group. Such a circumstance is far from disturbing. It has so far proved difficult to establish absolute homologies between the cortices of different species. Brodmann himself never envisioned an absolute transfer of this sort. The author regards the discrepancy as a reflection of the probability that what Freeman and Watts are calling 8 in the human is a trifle farther posterior in the cortex than what he calls 8 in the monkey. Such a difference in interpretation would naturally throw the representation of the regions in question to one side or the other of the internal medullary lamina of the thalamus. Even within a

single species, the cortical representation of area 8 is variably represented by different authors.

Another discrepancy between the maps for the monkey and man is the representation of area 12, which in the monkey is rostral but in man caudoventral. Presumably this indicates that the human medial nucleus has been rotated forward along a horizontal axis for a distance of about 90°.

Freeman and Watts' paper contains an incidental note on the degeneration of the centromedian nucleus after striatal injury and sparing of this nucleus after pallidal damage. The author's opinion thus far has been that the centromedian nucleus is devoid of cortical connections and projects upon the pallidum rather than striatum. Review of the original cases (J33, Mettler, '43 and '45a; J100, Mettler, '45 and J148, Mettler, '45b) leaves no doubt as to the accuracy of the first observation, but an absolutely unimpaired pallidum in the complete absence of the striatum is hard to come by and it is more difficult to be certain about the second point.

In a case (J209) at hand, the head of the right caudate, front of the corresponding putamen and the intervening capsule had been destroyed. On the left the lesion removed all of the striatum and the external part of the pallidum. The left but not right centromedian nucleus was very gliotic but, since the specimen was a Marchi, it was very difficult to tell what the condition of its neurocytes may have been. Although gliosis is not an accurate index of retrograde degeneration, this case would suggest that the centromedian nucleus had a dual representation—to both parts of the corpus striatum.

Additional light on the matter may be obtained from the following case (Rhesus J171) in which the left centromedian nucleus was fulgurated (9/15/44) by means of an electrode carried in the stereotaxic instrument. The animal showed no definite, consistent, physiologic abnormality and was killed 18 days later. It showed a lesion which began at the level of the posterior commissure, just between the medial geniculate and medial longitudinal fasciculus, and extended forward, in the dorsoventral third of the intramedullary lamina, to a level just rostral to the optic chiasm. The centro-median nucleus was practically all destroyed and there was little damage beyond its limits. There were two well-marked groups of degeneration emanating from the lesion. By far the most abundant of these moved directly laterally, through the internal capsule and came to lie in its lateral portion, just medial to that part of the putamen which projects dorsal to the pallidum. This group of degenerated fibers continued backward in this position.

At the level of the caudal part of the optic chiasm a considerable number of degenerated fibers moved into the medullary lamina between the pallidum and putamen. They broke up into smaller elements in this position. A considerable number of these smaller elements became lost in the putamen. None could be traced to the pallidum.

Many large degenerated fibers retained their original position in the internal capsule and, in sections through the level of the preoptic recess, moved farther medially and were joined by degenerated fibers emanating from the site of the needle track through the front part of the dorsal thalamus. These larger fibers, which continued into the corona radiata, must have emanated from that part of the arcuate nucleus which adjoins the centromedian for no fibers from the centromedian nucleus are distributed to the cortex.

It is worth observing that the centromedian fibers to the putamen do not accompany any of the efferent systems from the lentiform nucleus at any place except where these interdigitate with the fibers of the internal capsule.

The second group of degenerated fibers which emanate from the centromedian nucleus consists of a small number of elements which run into the pes pedunculi and run caudally for a short distance. They cannot be traced very far.

The diagrams of the thalamo-cortical systems have, therefore, been modified with regard to the thalamo-frontal projections. Attention should be called to the fact that the centromedian projection is a relatively small one which does not lie in the position of well-defined bundles of heavy fibers. The large fiber mass which passes from the thalamus to the medial segment of the pallidum (Mettler, '45a) must consequently emanate from another nuclear mass of the intralaminary group or in close association with this. This subject may be left for consideration at a later date.

(Author's abstr.)

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On the Etiology of Dementia Praecox.

The literature of the past ten years concerned with the problem of etiology of schizophrenia or dementia praecox has been presented. One is impressed with the wide variety of etiological factors reported. While some of the etiological factors presented are almost completely hypothetical and theoretical, others seem to be well founded and of the latter there are many of different etiology. It is difficult for the authors to assume that so many of the investigators based their impression on insufficient evidence. Rather, they are driven to the following conclusions:

(1) Schizophrenia or dementia praecox is not a disease entity, but a syndrome or a reaction-type associated with a large variety of etiological factors. The best common denominator which the authors can find for the syndrome is to call it a deficit reaction. By calling the schizophrenic syndrome or reaction type a deficit reaction, they mean that it is typical of a human organism incapable of adequate social functioning.

(2) The etiological factors of the deficit reaction, known as schizophrenic reaction type or schizophrenic syndrome, may range from a hypothetically completely psychogenic nature to a hypothetically completely organic nature. One can conceive of all the cases actually occurring as being on some points of a continuum from a hypothetical locale of complete psychogenicity to a hypothetical locale of complete organicity of the syndrome. As relatively completely psychogenic one the authors would consider a case in which the early childhood setting is consistent with dynamic conceptualization of a traumatic character formation, particularly in the psychoanalytic sense; where character manifestations can be dynamically understood as forms of maladjustment; where the onset of the disease is more or less manifestly associated with psychological trauma and where many manifestations can be understood, interpreted, predicted, and controlled on the basis of psychological operations. Hypothetically speaking, by completely organic etiology one understands a case in which there is an absence of a psychological background, where the onset is abrupt, sudden and unrelated to mental factors and where there are associated clinical, laboratory data or postmortem data indicative of organic pathology related to the schizophrenic syndrome.

One might wish to consider as a case of predominantly organic causation of an essentially schizophrenic type those cases of mental disease where, with our modern means of diagnosis, we can establish a luetic etiology of the mental picture that otherwise would be definitely diagnosed as dementia praecox. The authors would conceptualize such a case as the schizophrenic type being due to destruction or dysfunction of brain tissue by *Treponema pallida* and corresponding to an organic deficit. However, in such cases they feel—as many investigators do—that the psychotic manifestation of this luetic deficit is definitely determined by the previous

(psychologically caused) personality type. One might compare it to problems of gross brain injury—for instance, the frontal lobe lesions—in which most investigators feel now that the characteristics caused by the brain lesions are mostly accentuations of the previously existing personality type.

And, incidentally, one feels that in this direction those studies concerned with a biochemical aspect of the disease process deserve at present the greatest optimism, particularly those concerned with biochemical processes of an enzymatic nature concerned with the metabolism of the brain tissue.

(3) The authors believe a definite predisposition may be of importance in the etiology of the schizophrenic reaction type and that these predispositions may be of a constitutional nature, somatically speaking or socio-psychologically speaking. However, each case of schizophrenic reaction must be understood as an interaction between somatic or socio-psychological predisposition, and of a precipitating factor on that continuum between complete psychogenicity and complete organicity. The authors believe, for instance, that there may possibly be such a thing as diencephalic asthenia as revealed in electroencephalographic studies; they agree with Grinker that such diencephalic weakness may not at all be the essential determining factor in bringing about the schizophrenic reaction type, but that for instance a traumatic psychological background may be necessary to lead to the insidious onset of the disease symptoms. They also feel that a precipitating somatic and/or psychological factor may be necessary to bring about a deficit reaction superimposed upon a neurological predisposition. The authors believe that each case of schizophrenic reaction type must be considered as a psychosomatic problem of individual unique variations.

(4) Therefore, it is suggested that every case of schizophrenic reaction type be considered on the following four dimensional schemes, namely:

(a) Somatic predisposition.

(b) Socio-psychological predisposition.

(The two together might be conceptualized as threshold for schizophrenic reaction type liability.)

(c) Psychological precipitating causes.

(d) Somatic precipitating causes.

For statistical purposes the authors believe that each of these factors should be expressed on a three-point scale or a five-point scale or a seven-point scale, whichever may turn out to be the most practicable. It is suggested that such a scheme be used even in clinical diagnosis and that in the long run, if and when it proves advantageous, it be made part of the nosological classification system and the subtypes officially adopted.

Furthermore, it is suggested that research concerned with the etiology of schizophrenia be organized with such a scheme in mind. It is believed that work on the etiology of schizophrenia failed because of lack of awareness of the multiplicity of causes, and that research concerned with the constitutional background, more specifically the body type associated with the schizophrenic reaction type, may profit from selecting only cases in which apparently the predisposition was the most important factor, that is predisposition of a non-socio-psychological character, and where the precipitating causes were relatively at a minimum. It is felt that under those circumstances much more uniform results will be arrived at than has been possible so far.

(Authors' abstr.)

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The Pattern of Enzyme Distribution in the Brain and Mental Function.

(1) A pattern of distribution of carbonic anhydrase in the central nervous system is described and attention is called to its consistency of occurrence. In

the human brain changes in its pattern of distribution appear to accompany abnormality in mental function.

(2) A theory is propounded which would account for mental disfunction on the basis of an imbalance in the potentialities for metabolic activity caused by a disturbance in the quantitative incidence of essential enzymes.

(3) It is advocated that the quantitative distribution of enzymes involved in neuron metabolism be comparatively studied in brains which have shown normal and abnormal functioning, in the hope of elucidating the problem of mental abnormality. (Author's abstr.)

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Effects of Vitamin and Hormone Treatment on Senile Patients.

Small groups of male senile patients were treated: (i) With small doses of vitamins B and C; (ii) with increased doses; (iii) with androgenous hormones. The patients, together with similar numbers of untreated controls, were tested individually with a large battery of mental and psychomotor tests before treatment and during each phase of treatment.

No evidence was obtained of any general improvement in intellectual efficiency or psychomotor capacities as a result of the treatment. There were slight indications of an improvement on general intelligence (g) tests among the more severe cases with vitamin treatment; and among the light and moderate cases the same treatment produced an increase in fluency and a decrease in perseverative tendencies (f and p factors).

Though these improvements amounted to about 10 per cent., they were of doubtful statistical significance and require confirmation with larger and more homogeneous groups of patients. Neither the psychomotor tests nor tests of intellectual deterioration were affected in any consistent manner. The increased vitamin treatment did not yield any more positive results, and the hormone treatment was apparently quite ineffective.

The lack of any clear-cut effects of treatment may have been due partly to the fact that the patients were already on a diet adequate in vitamins, and partly to the unreliability of psychological tests when repeated too frequently over too long a period. (Authors' abstr.)

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The Nervous System as Physical Machine: With Special Reference to the Origin of Adaptive Behaviour.

An outstanding property of the higher nervous system is that, in contact with a new and previously unexperienced environment, it develops and produces behaviour which is adapted to that environment. It is usually assumed that the behaviour depends on the development of an inner, neuronic organization. But considering that the neurons might as easily develop one of the almost infinite wrong organizations, the fact that the right one is developed calls for explanation. Why should a network of neurons produce adaptive instead of chaotic behaviour? Psychology cannot rest content until it has found a physical answer to this problem.

The author has approached this problem from the point of view that the brain is a physical machine, and that "adaptive" behaviour is that which maintains it in physical equilibrium with its environment. This basic theme has been studied with all possible generality and precision. This has necessitated the construction of a special mathematical technique, and this has led to a number of new theorems on equilibrium and organization in generalized dynamic systems.

The problem of a self-equilibrating physical system can now be attacked with both rigor and generality. The paper then shows how these new methods provide an essentially simple and clearcut solution to the problem. (Author's abstr.)

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Emotional Disturbances in Epileptic Children.

Fourteen years after the organization of the Epilepsy Clinic at the Johns Hopkins Hospital, a follow-up study was made of 472 of the children. Among the many objectives of the study was a desire to know how many of them had been able to maintain a satisfactory place in society, and in what measure personality maladjustments accounted for the failures. The study was conducted by a trained social worker, and extended over a period of nearly two years. Every attempt was made to record facts rather than impressions and to draw conclusions in as objective a way as possible. The details of the study have been presented elsewhere, but the central conclusions will be of interest here.

The major handicap of a large group of epileptic children, two to fourteen years after first being seen in the Clinic, was found not to be the seizures themselves or mental retardation, but the personality disorders. In some, the seizure had disappeared after a period of years, but left an individual who was unable to associate with others in a satisfactory way, or to carry on constructive remunerative work. In others, while seizures had continued to recur at intervals, these would not have interfered with employment or home-making had the individual been more stable, and less helpless and resentful when confronted with difficulties. It was also rather startling to find how satisfactory some patients were getting along in spite of recurrent seizures and perhaps some degree of mental retardation, provided their dispositions and attitudes had not been warped by the disease and the problems they had met. In spite of the fact that earlier in this report only 9 per cent. of epileptic children were classified as having serious personality disorders, as years

go by the handicap of this aspect of the disease evidently assumes ever greater proportions. It appears that if the much larger group of epileptic children who show lesser grades of maladjustments are not given the benefit of expert care, the psychological problems tend to mount and eventually become the most serious handicap to normal living.

The outlook for the child with epilepsy is in many ways more favorable than has been thought in the past. Not only is medication more effective, but there is a growing appreciation of the many factors which contribute to the disease in any one individual, and with it a more sound basis for therapy. The realization that personality problems may contribute both to the causation and continuation of the disease has opened the way for preventive measures along these lines. There are at present lacks in facilities, time and interested personnel to carry on such work. However, in view of the obvious importance of such efforts to the individual and to the public as well, it is to be hoped that more emphasis will be placed in these directions in the future. (Author's abstr.)

Rorschach Psychodiagnosis in a Group of Epileptic Children.

In the light of the Rorschach psychodiagnosis, epileptics show a characteristic picture which can be summarized as follows:

(a) Deficient intellectual control over the affective emotional and instinctive spheres.

(b) Anxiety.

(c) Aggressiveness.

(d) Predominantly extravert reaction type.

(e) Tendency towards opposition.

(f) Poor mental efficiency.

(g) Slight bradypsychia.

None of the above traits can be considered pathognomonic. The syndrome of *grand mal* can be distinguished from that of *petit mal*. In the former the syndrome of anxiety is very strong; while in the latter, especially in its psychomotor form, the author finds aggressiveness, lack of prudence and of intellectual control over the affective sphere. The mental deterioration is greater in *grand mal* than in *petit mal* and its various forms.

In so far as foretelling behavior is concerned, the author admits that the protocol of the patients with behavior disorders cannot be distinguished from that of persons with deficient learning capacity.

The clinical forms which are revealed through the use of the electroencephalograph can be divided by the application of the Rorschach test into two groups: *grand mal* and *petit mal* with psychomotor disorders.

The Rorschach test shows that in epileptics the light-dark responses are as typical as C and CF.

The division of the epileptics into two groups, A and B, and the one which the author's results show between *petit mal* and the psychomotor form, corresponds to the opinion of Guirdham that there is no fixed type of epileptic reaction.

The author believes that the results permit him to speak of psychic epilepsy without clinical manifestations. This is the form called psychomotor, which corresponds to a definite type of cortical dysrhythmia and to a specific psychic picture as revealed by the Rorschach tests. (Author's abstr.)

Drug Therapy for Epileptic Children.

Successful drug therapy of epilepsy means individual treatment of the individual patient and his particular type of seizure. One or more of eight different types may be present. Convulsive seizures are best treated with dilantin, phenobarbital, mesantoin or mebaral; psychomotor seizures with dilantin (possibly combined with tridione); and the *petit mal* triad with tridione. Attention to dosages and to side-effects is a requisite of success. (Author's abstr.)

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1. Psychiatry, Physiology, Biochemistry, etc.

Notes on the Results of Army Intelligence Testing in World War I. [*Science*, **104**, 231-232 (1946).]

It has been argued that although data from the Army Alpha test should not be relied upon too strongly in making statements regarding the relative intellectual status of Negroes and whites because this test depends so much upon educational factors, greater reliance can be placed upon the Army Beta scores, inasmuch as these are presumably not influenced by educational and socio-economic status to so great a degree as the Alpha scores. Rank order correlations between median Beta scores for the various states and median Alpha scores, annual educational expenditures and *per capita* income range between .50 and .81. The order of magnitude of the coefficients for whites and Negroes, with respect to these measures are comparable. Such data probably most reasonably warrant the conclusion that Beta scores, like Alpha scores, reflect cultural factors concomitant with the socio-economic levels of the states.

F. A. MOTE (Psychol. Abstr.).

Aphasic Language Disorders. [*U.S. War Dep. tech. Bull., TB Med.* **155**, 3 (1945).]

The purpose of this bulletin was to establish uniform methods of study and management of aphasic language disorders in military hospitals. The neurological section was responsible for the early study and treatment of cases of disorder. A clinical psychologist was assigned the function of psychological evaluation of the brain-injured patient, and collaborated with the neurologist in the retraining of aphasic disorders. In addition to the usual clinical, neurological survey, mental testing of aphasic patients was done routinely as part of the neurological study. The following mental tests were recommended: (1) Army General Classification Test (retest) or basic battery; (2) Wechsler-Bellevue Intelligence Scale; (3) Goldstein-Scheerer Cube Test of Abstract and Concrete Behavior; (4) additional tests from the U.S. War Department Pamphlet No. 12-9, *Handbook for Clinical Psychologists*; and (5) writing complex sentences from dictation, repetition

of phrases, oral reading, simple arithmetic, clock reading and setting, color naming, naming of common objects, and use, manipulation, and identification of common objects (searching also for apraxia and astereognosis). Suggestions for retraining are included.

C. P. FROELICH (Psychol. Abstr.).

An Experimental and Comparative Study of Electroshock and of Cortical Epilepsy. [Rev. Neurol., **77**, 57-70 (1945).]

Experimentation is reported to the effect that cortical epilepsy and experimental electroshock constitute one and the same process as far as their manifestations are concerned. While cortical epilepsy affects the cerebral cortex, experimental electroshock affects the pyramidal system. The authors believe the findings warrant a new conception of epilepsy to the effect that epilepsy, whether cortical or electroshock, is a general mode of reaction of nerve cells and not an exclusive property of the cortical cortex as has been believed.

F. C. SUMNER (Psychol. Abstr.).

Mental Breaking Points. [New Engl. J. Med., **234**, 42-45 (1946).]

Two thousand naval service returnees were interviewed and given (1) the Cornell Selectee Index, (2) a psychosomatic inventory consisting of 64 questions, designed to elicit evidence of emotional instability. Of the entire group, 500 were survivors of sunken ships, 1,000 had combat duty, and 500 were overseas but did not encounter combat. Of the 2,000 only 5 per cent. showed evidence of severe nervous symptoms, and only $\frac{1}{2}$ per cent. (10 men) needed hospitalization for mental or emotional disorder. The author points out that 95 per cent. of the returnees were normal, and that the neuroticness of veterans has been overstressed both by the medical profession and by laymen. It is considered unfortunate that the normal 95 per cent. are often treated, upon return home, as if they were members of the 5 per cent group.

G. W. KNOX (Psychol. Abstr.).

Further Studies on the Biochemistry of Reflex Activity. III. Creatine of the Central Nervous System and Reflex Activity. Mitolo, Michele (Univ. Bari, Italy). [Boll. soc. ital. biol. sper., **18**, 277-8 (1943); cf. C. A., **40**, 6603³; **41**, 1936.]

Freshly isolated toad spinal cord contained, in mgm. per 100 gm. fresh tissue, free creatine, 50.7, combined creatine, 38.7, "residual creatine," 39.6, and total creatine, 129. After 4 hours in repose the corresponding values were 52.7, 32.2, 41.2 and 126 mgm. per cent. After 4 hours of reflex activity provoked as previously described the values were 75.8, 31.7, 44.4 and 152 mgm. per cent. The free and combined creatine were extractable by $\text{CCl}_3\text{CO}_2\text{H}$ solution. The so-called residual creatine was not extracted by $\text{CCl}_3\text{CO}_2\text{H}$ solution and was not creatine, but an unknown substance which gives the Jaffé color reaction like creatine.

L. E. GILSON (Chem. Abstr.).

Swelling of Brain Slices and the Permeability of Brain Cells to Glucose. Elliot, K. A. C. (McGill Univ., Montreal, Can.). [Proc. Soc. Exptl. Biol. Med., **63**, 234-6 (1946).]

Brain slices swell considerably in solutions of the common salts and sugars, even though the concentration of the solutions is 2-4 times isotonic with serum. Brain tissue behaves as if freely permeable to glucose, fructose, and sucrose in the absence of electrolyte, but impermeable to sugars in the presence of a small amount of a salt. Small additions of substances known to affect permeability *in vivo* or nervous activity (adrenal cortical extract, acetylcholine, eserine, metrazole, Na pentobarbital) did not significantly affect the swelling in isotonic NaCl solution or in a mixture of 1 volume isotonic NaCl and 9 volumes isotonic glucose.

L. E. GILSON (Chem. Abstr.).

Effect of Excitation on Nerve Permeability. Euler, H. v., Euler, U. S. v., and Hevesy, G. (Karolinska Inst., Stockholm). [Acta Physiol. Scand., **12**, 261-7 (1946).]

When the sciatic nerve of the cat is stimulated by condenser shocks 50 times per second, giving maximum motor reactions, the nerve permeability is increased over that of the resting state (as demonstrated by means of radioactive isotopes of K, Na, P and Br) in the ratio of 1.55 ± 0.10 .

S. MORGULIS (Chem. Abstr.).

Inhibition of the Anaerobic Glycolysis of Rat Brain by Adrenochrome. Randall, Lowell O. (Wellcome Research Labs., Tuckahoe, N.Y.). [*J. Biol. Chem.*, **165**, 733-4 (1946).]

The glycolytic rate of rat-brain homogenates was measured by the manometric method of Utter, Wood, and Reiner (*C. A.*, **40**, 1217⁷). Anaerobic glycolysis of rat-brain homogenates was inhibited by small concentrations of adrenochrome. Adenosinetriphosphate (ATP) increased the rate of glycolysis and partially overcame this inhibition. 0.001 mgm. of adrenochrome inhibited the glycolytic rate by more than 50 per cent., while, in the presence of 1 mgm. of ATP, 0.02 mgm. of adrenochrome was required for a 50 per cent. inhibition. The fact that ATP partially counteracted the inhibition produced by small concentrations of adrenochrome indicates that the latter inhibits the phosphate-transfer mechanism of the glycolytic cycle. Since oxidizing agents, such as iodine, quinone and dichlorophenolindophenol produce an inhibition of glycolysis which is counteracted by glutathione, the possibility is suggested that adrenochrome also produces inhibition by a reversible oxidation of the sulfhydryl groups of the enzymes of glycolysis.

HILDA H. WHEELER (Chem. Abstr.).

Calcium Ions in Neuromuscular Transmission. Coppee, G. (*Inst. Leon Fredericq, Liege*). [*Arch. intern. physiol.*, **54**, 323-36 (1946).]

Ca ions in physiological concentration assure maximum security for transmission of excitation, for regulation of the voltage of the response of motor bases and of the critical voltage, and for prevention of repetitive response.

H. L. WILLIAMS (Chem. Abstr.).

Asphyxial Depolarization in the Spinal Cord. Harreveld, A. van. (*Calif. Inst. Technol., Pasadena*). [*Am. J. Physiol.*, **147**, 669-82 (1946).]

The existence of depolarization potentials during asphyxiation of the cord was studied, and an attempt was made to correlate the changes in the polarized structures thus recorded with the changes in the reflex activity during the development of and the recovery from asphyxia.

E. D. WALTER (Chem. Abstr.).

Circulatory Modifications in the Brain in the Course of Experimental Pyruvate Poisoning. Dobrovolskaia-Zavadskaja, Nadine. [*Compt. rend.*, **223**, 519-21 (1946); cf. *C. A.*, **40**, 3526².]

Animals were treated with Na pyruvate (I) alone, NaCl (II) alone, or a combination of (I) and (II). The brains of the dead animals were examined microscopically. The hyperemia produced by (I) was slightly less than that produced by (II). Diffuse edema was not observed, but there was a dilatation of the perivascular pericellular spaces. Large veins contained blood, but small vessels were completely collapsed by the pressure of the fluid. This was most marked when animals were treated with (I) and (II). The administration of vitamin B₁ with (I) or vitamin PP with pyruvic acid did not save the life of the animals, but the brain showed less alteration.

RACHEL BROWN (Chem. Abstr.).

Chronaximetric Study of Experimental Chronic Alcoholic Intoxication; Attempted Protection by Sugars and Thiamine. Chauchard, Paul, Mazoue, Henriette, and Lecoq, Raoul (Sorbonne, Paris). [*Compt. rend. soc. biol.*, **140**, 47-8 (1946).]

Daily administration of EtOH (5-10 gm./kgm.) to rats caused a decrease in nerve chronaxia and an increase in muscle chronaxia, similar to the changes seen in polyneuritis and acidosis. Feeding glucose or lactose had a slight corrective effect; thiamine or riboflavin or both together had no beneficial effect on chronaxia.

L. E. GILSON (Chem. Abstr.).

Radiopotassium Autography of Rat Brain. Colfer, Harry F., and Essex, Hiram E. (Mayo Foundation, Rochester, Minn.). [*Proc. Soc. Exptl. Biol. Med.*, **63**, 243-4 (1946).]

K⁴², as chloride, was injected intraperitoneally in rats in a dose of 0.75 milluries per 100 gm. body-weight. After 12-18 hours the brain was removed and

cut in slices 6–12 μ thick. The slices were placed on dental x-ray film for 12–24 hours, then the films were developed. It was found that the distribution of K⁴² in the brain was fairly homogeneous, except for slightly greater concentration in the cerebral and cerebellar cortex, the basal ganglia, and the roof of the fourth ventricle.

L. E. GILSON (Chem. Abstr.).

Prolongation of Consciousness in Anoxia of High Altitude by Glucose. Riesen, Austin H., Tahmisian, T. N., and Mackenzie, Cosmo G. (Yale Univ.). [Proc. Soc. Exptl. Biol. Med., **63**, 250–4 (1946).]

Preflight administration of 80 gm. of glucose in water to individuals on a normal diet produced a significant increase in the resistance to unconsciousness from anoxia at 27,000–30,000 ft. The protection afforded flying personnel by the glucose solution was greater 30–50 minutes after ingestion than at 60–80 minutes after ingestion. At 27,000 ft. the average duration of consciousness was increased approximately 40 per cent., or more than 1 minute. Vitamin C, alone or with the glucose, had no demonstrable effect on the duration of consciousness.

L. E. GILSON (Chem. Abstr.).

The Relation Between Sulfhydryl Groups and Pyruvate Oxidation in Brain Tissue. Peters, R. A., and Wakelin, R. W. (Oxford Univ.). [Biochem. J., **40**, 513–16 (1946).]

The pyruvate oxidase system and the pyruvate dehydrogenase component are much more sensitive than succinic-dehydrogenase to Na maleate. Likewise, pyruvate dehydrogenase can be inactivated by cystine and reactivated by cystine ester. These effects are thought to be due to the presence of an essential —SH group in the enzymes.

S. MORGULIS (Chem. Abstr.).

Biochemistry of Reflex Activity. I. Phosphorylation of Glucides of Nervous Tissue and Reflex Activity. Mitolo, Michele (R. Univ. Bari). [Arch. fisiol., **42**, 1–24 (1942).]

The distribution of P in cerebrospinal tissue of frogs after 4 hours of apparent repose and after 4 hours of reflex activity respectively was: Inorganic P 32.5 and 35.6 mgm. per cent.; phosphocreatine P 0.00 and 0.00 mgm. per cent.; pyrophosphate P 19.3 and 11.3 mgm. per cent.; difficultly hydrolyzed P 84.8 and 61.6 mgm. per cent.; and acid-soluble P 136.6 and 108.5 mgm. per cent.

H. L. WILLIAMS (Chem. Abstr.).

Intracranial Neoplasms Produced in Dogs by Methylcholanthrene. Mulligan, R. M., Neubuerger, K. T., Lucas, J. T., jun., and Lewis, W. B. (Univ. of Colorado School of Med., Denver). [Exptl. Med. Surg., **4**, 7–19 (1946); cf. C. A., **39**, 744⁶.]

Implantation of 100 mgm. methylcholanthrene in gelatin capsules beneath the dura over the right frontoparietal area of the cerebrum led to the production of intracranial neoplasms (extracerebral fibrosarcoma, glioma, and sarcomatous meningioma) in 378–436 days in 3 of 7 young male mongrel bulldogs.

MARION HORN PESKIN (Chem. Abstr.).

Curare and the Rigidity of Decerebration. Minz, B., and Veil, Catherine (La Sorbonne, Paris). [Compt. rend. soc. biol., **140**, 466–7 (1946).]

The body rigidity produced in rabbits by section of the nerve axis between the anterior and posterior corpora quadrigemina disappears immediately after injection of 0.75 mgm./kgm. of orthocurare. Normal respiratory movements continue. Electric stimulation of the sciatic nerve produces muscle contraction, and intra-arterial injection of acetylcholine into a leg artery causes contraction of the muscles served. Since the peripheral sensory and motor apparatus thus remains intact, it appears that the action of the curare is central. An hour or more after the curare injection a state of complete rigidity again gradually develops.

L. E. GILSON (Chem. Abstr.).

Studies of Indophenol Oxidase on the Central Nervous System. II. Indophenol Oxidase of the Various Portions of the Nerves of Animal and Man. Mitolo, Michele (Univ. Bari, Italy). [Boll. soc. ital. biol. sper., **22**, 221-4 (1946); cf. C. A., **40**, 6531⁵.]

Different portions of the nerves of 14 species of animal and man were tested and the results charted. There was a great variation in the indophenol oxidase power in the various species. In general the power was less as the animals descended in the zoological scale. The indophenol oxidase activity was always greater in the grey matter of the nerves than in the white.

HELEN LEE GRUEHL (Chem. Abstr.).

The Blood Glucose : Spinal Fluid Glucose Ratio. I. Its Variations in Experimental Hypoglucemia. Tolone, Salvatore (Univ. Naples). [Boll. soc. ital. biol. sper., **19**, 305-6 (1944).]

In normal dogs the blood glucose : spinal fluid glucose ratio averages 1.54, as compared with 1.77 for human subjects. In dogs the hypoglucemia provoked by injection of appropriate doses of insulin, thiamine or nicotinic acid is followed by a decrease in spinal-fluid glucose, but the changes are very slight compared to those in the blood.

II. *Its Variations in Experimental Hyperglucemia.* [Ibid., 306-8.]

Hyperglucemia provoked by injection of glucose, metrazole, adrenaline, or synthetic adrenocortical hormone (cortenil Bayer) was accompanied by relatively slight increases in spinal fluid glucose. The injection of adrenaline into the spinal canal produced the same effects as intravenous injection.

L. E. GILSON (Chem. Abstr.).

Production of Electricity by Nerve. Barnes, T. Cunliffe, and Beutner, R. (Hahnemann Med. Coll. and Hosp., Philadelphia, Pa.). [Science, **104**, 569-70 (1946).]

Previously it has been reported (C. A., **35**, 7431¹; **37**, 1435⁵; **39**, 2298⁸; **40**, 1548⁶, 1580¹, 4785³) that the chemical mediator of the nerve impulse, acetylcholine (I), sets up a negative phase boundary potential in the lipide layer of the nerve fiber. The lipide-soluble (I) dissolves in the oil layer to a much greater extent than in the saline, thus establishing a true phase-boundary potential, which can be demonstrated on an oil layer several cm. thick, thereby eliminating any permeability changes in an imaginary sieve membrane. When cholesterol is added to the oil layer, the phase-boundary potential is increased. A filtered cat-brain extract with guaiacol gives 45 mv. negative potential with 0.05 per cent. added (I) in contrast to 30 mv. from 0.05 per cent. (I) in guaiacol without brain extract. The addition of human serum, which contains serum cholinesterase and small amounts of cell cholinesterase, to the saline phase brings the oil cell model still closer to living nerve. Four c.c. of human serum added to 200 c.c. of 0.9 per cent. NaCl with NaHCO₃ to make pH 8.2, at 37° for 8 hours, destroys the electrogenic activity of 0.05 per cent. (I) as tested in the oil cell. This demonstrates that it is the (I) and not the esterase which produces the electric nerve impulse. The rise and fall of the spike potential in peripheral nerve can be duplicated in the oil cell by placing the (I) first on one side and then on the opposite side of the oil layer. With resin in the oil a film less than 0.1 mm. thick can be formed by pressure on the saline on one side. Under these conditions a potential of 30 mv. produced by 0.05 per cent. (I) falls to 0.0 in 4 hours, due to penetration of the alkaloid to the opposite side. (I) is the only substance so far found capable of producing the action current in nerve. Triglyceride oils establish potentials with sympathomimetic, but not with parasympathomimetic drugs. The study of the phase-boundary potential can be applied directly to nerve. Frog sciatic nerve is immersed in isotonic glucose for 1-2 hours to eliminate short circuits by salts. The ends are tied, and the nerve forms a loop between 2 watch-glasses of isotonic glucose connected to a potentiometer. Addition of 1 : 160,000 (I) to the solution bathing the part of the nerve in one dish sets up a phase-boundary potential of 10 negative mv., the magnitude of which decreases with time. These experiments support the theory that the electric nerve impulse is a phase-boundary potential produced by (I) in contact with nerve lipides.

BRUNO VASSEL (Chem. Abstr.).

Influence of Glucose Loading on the Glucose of Spinal Fluid in Tuberculous Meningitis. Cicala, V., and Robertaccio, A. (*Hosp. Domenico Cotugno, Naples*). [*Boll. soc. ital. biol. sper.*, **19**, 193-5 (1944).]

The glucose content of spinal fluid is below normal in tuberculous meningitis, and shows little or no increase after oral administration of glucose.

L. E. GILSON (Chem. Abstr.).

Endogenous Purine Metabolism and the Vegetative Nervous System of the Endocrine (Glands). (1) *Influence of the Thyroid (Gland) on the Endogenous Purine Metabolism.* Rubino, A. (*Univ. of Sassari*). [*Policlinico (Rome) Med. Pt.*, **48**, 349-68 (1941).]

Four subjects at rest and on purine-free diets were injected with the thyroid hormone preparation elityran (Bayer), 3-4 ampoules per day for 4 consecutive days (strength of dose not given). Diuresis tended to increase after the hormone administration. Uricacidemia, uricaciduria, and total purine substances decreased. The purine bases at first followed the shape of the uricaciduria curve, then instead of a pronounced minimum, showed a sharp maximum. This rise in intermediary products of purine metabolism indicates stimulation of nucleo-protein katabolism under influence of the thyroid and increased rate of oxidative processes. The decrease of uric acid in the blood accompanied by its diminished excretion suggests the strong possibility that it is further decomposed in the human body. These experiments give support to the view that the thyroid gland stimulates uricolysis in the liver.

C. S. SHAPIRO (Chem. Abstr.).

Preparation and Chemistry of Anterior Pituitary Hormones. White, Abraham (*Yale Univ.*). [*Physiol. Rev.*, **26**, 574-608 (1946).]

The six hormones obtained in the last decade from the anterior pituitary are proteins and appear to be individual hormones. The lactogenic, adrenotropic, growth and luteinizing hormones are the ones most highly purified; the thyrotropic has been highly purified, but its protein purity has not yet been rigidly established, while the gonadotropic or follicle-stimulating hormone must be purified further. The biological activity of these hormones seems to be intimately related to the protein nature of the substance, and the slightest alteration in its protein structure results in partial or complete loss of activity. The adrenotropic hormone seems to be an exception in that it retains biological activity even after a significant number of its peptide linkages have been split. So far it has not been possible to obtain evidence of the existence of some specialized active groups in these protein hormones, although glucide has been recognized as a component of the thyrotropic, gonadotropic, and luteinizing hormones. Enzymes which split glucide inactivate the gonadotropic hormone, and the glucide group may be important in its biological activity, but this conclusion must be regarded as tentative. There are some species differences among the pituitary hormones manifested in their physical and chemical properties, these being most striking for the luteinizing hormone.

S. MORGULIS (Chem. Abstr.).

Mechanism of the Development of Obesity in Animals with Hypothalamic Lesions. Brobeck, John R. (*Yale Univ.*). [*Physiol. Revs.*, **26**, 541-59 (1946).]

Biochemically the interruption of axons due to hypothalamic lesions profoundly alters the energy balance; this leads to a retention of large surpluses of energy in the form of neutral fat. All other metabolic changes are simply secondary manifestations of the specific deficiency in the regulation of energy intake and output. There is nothing remarkable about the chemical composition of the accumulated fat. The animals utilize it if the food supply is inadequate; besides, the respiratory quotients of fasting obese rats are within the normal limits. There is evidence, however, in animals with hypothalamic hyperphagia that the transformation of carbohydrate to fat is tremendously accelerated. Conclusion: The hypothalamus normally participates in the maintenance of the overall energy equilibrium, and the control of food intake, work output and body temperature may be correlated and integrated within this portion of the diencephalon.

S. MORGULIS (Chem. Abstr.).

Influence of Corticosterone on Neuromuscular Excitability and Fatigability. Borgatti, G. (Univ. Bologna, Italy). [Boll. soc. ital. biol. sper., **17**, 671-3 (1942); cf. C. A., **40**, 5150⁴.]

In frogs and guinea-pigs desoxycorticosterone acetate (in oil) was injected into muscle with connections to the central nervous system severed but circulation intact. The nerve excitability was markedly increased (chronaxia decreased) and the muscle excitability was slightly increased. As shown by the ergograph, the work capacity of the muscle was increased.

Influence of Male Sex Hormone on Neuromuscular Chronaxia and Ergograph in the Guinea-pig. [Ibid., 673-4.]

In experiments similar to the preceding, testosterone produced effects similar to, but less marked than those of desoxycorticosterone acetate.

Modification of Neuromuscular Excitability and Fatigability by Cholesterol. [Ibid., **18**, 3-4 (1943).]

Cholesterol injected into muscles produced effects similar to those of testosterone and desoxycorticosterone. L. E. GILSON (Chem. Abstr.).

The Selectivity of the Inhibition of the Gonadotropic Function of the Hypophysis Caused by Estrogenic Substances. Gaarenstroom, J. H., and de Jongh, S. E. (Rijks-Univ., Leyden). [Verslag. Gewone. Vergader. Afdel. Naturk. Nederland. Akad. Wetenschap., **52**, 446-52 (1943).]

There are at least two substances in the gonadotropic secretion of the hypophysis: one which stimulates development of the interstitial tissue of the testis, and another which initiates growth of the seminiferous tubules. Evidence for the presence of two distinct substances was obtained from transplantation experiments. The authors implanted hypophysis tissue both from rats which had been treated with estradiol benzoate and from untreated rats into the abdominal cavities of hypophysectomized rats. Hypophyses from treated rats produced less effect on the interstitial tissue of the testis of the receptor rats than did hypophyses from untreated rats, but had about the same effect on the seminiferous tubules. Another type of experiment also gave evidence of the plurality of hormones in the hypophysis. Administration of $\frac{1}{4}$ unit of pregnyl (placental gonadotropic hormone) daily for 12 days decreased both the germinal and the interstitial tissue in hypophysectomized rats, but increased both in normal rats; it did not affect the weight of the seminal vesicle. Administration of estradiol benzoate by itself decreased the weight of both interstitial tissue and germinal tissue of the testis of normal rats. Administration of both estradiol benzoate and pregnyl increased germinal tissue and decreased interstitial tissue. N. M. PAYNE (Chem. Abstr.).

The Influence of Vitamin B₁ on the Nervous System. Haex, A. J. Ch., and Gaillard, P. J. (State Univ. Leyden). [Acta. Brevia Neerland. Physiol. Pharmacol. Microbiol., **11**, 113-16 (1941) (in English).]

Nervous tissue from the optical lobe of chick embryos $7\frac{1}{2}$ to $8\frac{1}{2}$ days old was grown in a medium consisting of 1 volume chicken plasma, 1 volume press juice of chicken embryos 9 days old, diluted 1:2 with a physiological salt mixture (Titro salt), and 1 volume of a vitamin B₁ solution which was varied to give 1, 2.5, 5, 10, 12.5, 16.7, 25, 50 and 100 I.U. per explant. After culturing for two 24-hour periods the explants were fixed, cut into 10 μ slices and stained with cresyl violet. The control sections remained nearly unaltered. In those where the vitamin had been added to the medium a distinct development of normal fibroblasts occurred. This influence of the vitamin B₁ varied with the concentration, and was absent in those cultures which were grown with the largest amount of the vitamin. An optimal concentration of 10 I.U. per explant was established.

GERTRUDE E. PERLMANN (Chem. Abstr.).

The Influence of Thiamine on the Susceptibility of Chicks to Avian Encephalomyelitis. Cooperman, J. M., Lichstein, H. C., Clark, P. F., and Elvehjem, C. A. (Univ. of Wisconsin, Madison). [J. Bact., **52**, 467-70 (1946).]

One-day-old white leghorn chicks were divided into 3 groups, receiving a low, suboptimum, and optimum intake of thiamine, and inoculated with a virus sus-

pension of avian encephalomyelitis. The chicks receiving the highest level of thiamine were protected to the greatest degree. Another group of day-old chicks were given an optimum level of thiamine for 2 weeks, then divided into the 3 groups for 2 weeks and inoculated. In this case the chicks receiving the least thiamine were protected to the greatest degree.

JOHN T. MYERS (Chem. Abstr.).

Avitaminotic Ailments of the Nervous System in Besieged Leningrad. Razdol'skii, I. Ya. [*Klin. Med. (U.S.S.R.)*, **23**, Nos. 7-8, 14-19 (1945).]

Pellagra was the most common disease resulting from poor vitamin supply during the siege of Leningrad, although other forms of polyneuritis were widespread. Nicotinic acid was very effective as a therapeutic agent, although intralumbal injections of vitamin B₁ served excellently to combat the psychological symptoms of vitamin deficiency.

G. M. KOSALAPOFF (Chem. Abstr.).

Effect of Vitamins on Sensitivity of Striated Muscle to Acetylcholine and Potassium. Torda, Clara, and Wolff, Harold G. (Cornell Univ. Med. Coll., New York, N.Y.). [*Exptl. Med. Surg.*, **4**, 50-3 (1946); cf. *C. A.*, **40**, 6173^s.]

In the course of an investigation of the behavior of striated muscle in patients with myasthenia gravis, a search for substances modifying the sensitivity of striated muscle to indirect and direct stimulation was undertaken. The acetylcholine sensitivity of frog muscle was decreased in the presence of vitamins A and B₁ (higher concentrations), increased in the presence of riboflavin and menadione (higher concentrations), and not affected by p-aminobenzoic acid, nicotinamide, nicotinic acid, pyridoxine, Ca pantothenate, or vitamins C, D or E. The K sensitivity decreased in the presence of vitamin A and Ca pantothenate (higher concentrations) and increased in the presence of most of the other substances used, especially menadione.

MARION HORN PESKIN (Chem. Abstr.).

The Influence of Thiamine on the Action of Acetylcholine on Muscle. Sadhu, D. P. (Presidency Coll., Calcutta, India). [*Am. J. Physiol.*, **147**, 233-6 (1946).]

Thiamine in sufficiently high concentration annuls to various degrees the effect of acetylcholine, but not when the Ca-ion level is too low. Thiamine in high concentration annuls the effect of acetylcholine on the heart even in the presence of eserine. It prevents the inhibitory action of vagus stimulation on heartbeats.

E. D. WALTER (Chem. Abstr.).

The Direct Action of Prostigmine on Skeletal Muscle; Its Relationship to the Choline Esters. Riker, Walter F., jun., and Wescoe, W. Clarke (Cornell Univ. Med. Coll., New York, N.Y.). [*J. Pharmacol.*, **88**, 58-66 (1946).]

The destruction of muscle cholinesterase was effected by injecting an anticholinesterase, diisopropyl fluorophosphate (DFP), into the artery supplying the muscle. The characteristic contractile responses of cat leg muscle to the intra-arterial injection of acetylcholine or prostigmine (I) were essentially unaltered in the absence of cholinesterase. The effect of DFP on the activity of skeletal muscle differs from that of (I) in that it produces only scattered irregular fasciculations after a latent period of 2-5 minutes. The action of (I) appears to be primarily directly on the muscles and differs from that of an antiesterase. Because of the similarity in structure of (I) and the natural and synthetic choline esters it is reasonable to predicate a common basis of action for all.

L. E. GILSON (Chem. Abstr.).

Action of Cocarboxylase in the Synthesis of Acetylcholine. Minz, B. (Sorbonne, Paris). [*Compt. rend. soc. biol.*, **140**, 412-14 (1946).]

The dorsal muscle of the leech, in the presence of air, cocarboxylase, choline and eserine, rapidly forms a substance which causes the muscle to contract. Presumably choline is converted into acetylcholine and cocarboxylase in some manner aids the reaction.

L. E. GILSON (Chem. Abstr.).

Oscillations of the Tone of the Respiratory Muscles Provoked by Acetylcholine in Decerebrated Animals. Pupilli, G., and Bottoni, A. Sacchi (Univ. Bologna, Italy). [*Boll. soc. ital. biol. sper.*, **18**, 258-60 (1943).]

L. E. GILSON (Chem. Abstr.).

Sulphydryl Groups in the Action of Acetylcholine and Inhibition of the Vagus Nerve. Koshtoyants, Kh. S., and Turpa'ev, T. M. (*Acad. Sci. U.S.S.R., Moscow*). [*Nature*, **158**, 837-8 (1946).]

The cardio-inhibitory effect due to vagus nerve stimulation and acetylcholine is abolished after application of 10^{-3} and 10^{-4} HgCl_2 to the frog heart. HgCl_2 binds SH groups. The effect is restored after the heart is washed with 2×10^{-3} cysteine. The inhibition of acetylcholine action by atropine is not reversed by cysteine.

LEONARD J. COLE (Chem. Abstr.).

Action of Acetylcholine on Maximum Tolerance to Oxygen Deficiency. Scoz, G., and Michele, G. De (*Univ. Naples*). [*Boll. soc. ital. biol. sper.*, **19**, 3-4 (1944).]

In patients with pulmonary tuberculosis the subcutaneous injection of 100 mgm. of acetylcholine increased the tolerance to low concentrations of O but did not increase the total O consumption. Adrenaline had little or no such effect and glycerophosphates had no effect.

Action of Acetylcholine on the Erythrocyte Count of the Peripheral Blood. [*Ibid.*, 4-5.]

In the above experiments the acetylcholine produced a transient rise in the red cell count in the hour following the injection.

Action of Acetylcholine on Maximum Tolerance to Oxygen Deficiency and on the Erythrocyte Count. Michele, G. De, and Scoz, G. [*Ibid.*, 6-7.]

The two effects show no significant correlation.

Action of Histamine on Maximum Tolerance to Oxygen Deficiency. Michele, G. De. [*Ibid.*, 8-9.]

In pulmonary tuberculosis patients the intramuscular injection of 0.5 mgm. of histamine-HCl slightly decreased tolerance to air mixtures with lowered O content.

L. E. GILSON (Chem. Abstr.).

The Influence of Sodium Salicylate on the Action of Acetylcholine. Valenzuela, Manuel de Armijo (*Fac. Medicina Cadiz*). [*Farmacoterap. actual (Madrid)*, **3**, 684-9 (1946).]

Na salicylate in concentrations of 1 : 100,000 to 1 : 10,000 has no influence on the eserinizd dorsal muscle of the leech, but it reduces the response to acetylcholine. This effect changes to augmentation at concentrations of more than 2 : 10,000, when the salicylate becomes active directly. The action on the non-eserinizd muscle is similar, although at higher concentrations. Continued administration of Na salicylate to humans causes a decrease in acetylcholine activity of the spinal fluid.

A. E. MEYER (Chem. Abstr.).

Synthesis of Acetylcholine in Brain. Balbi, R. (*Univ. Naples*). [*Boll. Soc. ital. biol. sper.*, **18**, 285-7 (1943).]

The synthesis of acetylcholine by rat brain homogenate in Ringer solution containing eserine was demonstrated. The synthesis, at pH 7.4, was accelerated by glucose and Na pyruvate, lactate, acetoacetate, and acetate, the effectiveness decreasing in the order named.

L. E. GILSON (Chem. Abstr.).

Acetylcholine in the Blood of Patients with Gastric or Duodenal Ulcers. Al'pern, D. E. [*Klin. Med.*, **23**, Nos. 7-8, 52-4 (1945).]

See C. A., **40**, 7361⁹.

G. M. KOSALAPOFF (Chem. Abstr.).

Presence of Acetylcholine in the Blood of Patients with Ulcers. Bykhovskii, Z. E., and Koreneuskaya, O. G. [*Klin. Med.*, **23**, Nos. 7-8, 54-7 (1945).]

The authors found acetylcholine in the blood of 60.4 per cent. patients suffering from gastric or duodenal ulcers, with the level corresponding usually to the gravity of the case. Most frequent occurrence was observed in cases involving the parasympathetic nervous system.

G. M. KOSALAPOFF (Chem. Abstr.).

Apparent Curare Effect of Substances that Decrease Acetylcholine Synthesis. Torda, Clara, and Wolff, Harold G. (Cornell Univ. Med. Coll., New York, N.Y.) [*Am. J. Physiol.*, **147**, 384-90 (1946); cf. *C. A.*, **40**, 2211⁹.]

Uric acid, pyrrole, alloxan, methylguanidine, vitamin K, NH_3 , hydroquinone, α -naphthol, β -naphthol and glyceraldehyde decreased the response of striated muscle to indirect stimulation. Serum collected from the working arm of human subjects also decreased the response of striated muscle to indirect stimulation and decreased the synthesis of acetylcholine without decreasing the response of excised muscle to acetylcholine. It is suggested that an apparent curare effect may be exerted by substances acting, not on some structure or process within the muscle, but on the nerve tissue.

E. D. WALTERS (Chem. Abstr.).

Nervous System Changes Produced in Dogs by Choline and Carbamylcholine. Davis, John E., and Fletcher, D. E. (Univ. of Arkansas, Little Rock). [*J. Pharmacol.*, **88**, 246-53 (1946).]

Hyperchromic anemia was produced in dogs by daily administration, for several weeks, of choline chloride or carbamylcholine or both. Definite changes in the nervous system were also produced. In the acute phase the lesions were characterized by multiple hemorrhages in the grey substance of the brain and spinal cord, and by a diffuse gliosis and acute neurone changes. After recovery from drug treatment, the lesions were characterized by perivascular gliosis, glial nodules, diffuse scar formation and neurone depletion. The similarity and differences between these changes and those found in pernicious anemia, and the possible etiological factors responsible for the changes, are discussed.

L. E. GILSON (Chem. Abstr.).

Studies on Choline Acetylase. III. Preparation of the Coenzyme and Its Effect on the Enzyme. Nachmansohn, David, and Berman, M. (Columbia Univ.). [*J. Biol. Chem.*, **165**, 551-63 (1946); cf. *C. A.*, **40**, 4403³.]

The coenzyme necessary (I) for the activity in nerve tissue of choline acetylase (II) was prepared from brain, liver, heart and skeletal muscle by grinding the tissue in a Waring blender with 1-2 times its weight of water, heating to 100°, and filtering. Proteins were removed from the filtrate by precipitation with AcOH and filtration. The filtrate was neutralized and showed coenzyme activity. (I) can be partially purified by precipitation with Ba(OH)_2 and redissolving with Na_2SO_4 . Boiling (I) in 0.1 N HCl caused more rapid loss in activity than did boiling in water, while boiling for $\frac{1}{2}$ hour in 0.1 N NaOH caused the disappearance of all the activity. While K and cysteine cause partial reactivation of dialyzed (II), (I) causes complete reactivation. Addition of (I) to undialyzed (II) increased the rate of acetylcholine formation. (II) was shown to be present in sensory nerves. Evidence was also found for the presence of (II) in invertebrates, since the addition of (I) to extracts of lobster abdominal chain caused a large increase in the rate of acetylcholine formation. Diisopropyl fluorophosphate, which inhibits cholinesterase, did not affect (II). Approximately doubled activity was exhibited by (II) if, in addition to (I), Mg or Mn was present. The effect of Mg was the same on dialyzed as undialyzed (II). Mg could not replace K. High-speed centrifugation at 48,000 r.p.m. increased the purity of (II), the activity being found in the bottom layer, which showed only one component. Methylnaphthoquinone and 2-methyl-1,4-naphthoquinone-8-sulfonic acid inhibited (II).

A. JEROME GANZ (Chem. Abstr.).

The Effect of Chloroform and Ether on the Activity of Cholinesterase. Miquel, Ovidio (Cornell Univ. Med. Coll., New York, N.Y.). [*J. Pharmacol.*, **88**, 190-3 (1946).]

Ether and CHCl_3 in concentrations corresponding to those attained during deep general anesthesia do not inhibit the activity *in vitro* of the nonspecific cholinesterase of cat serum and the specific cholinesterase of eel electric organ. Higher concentrations partially inhibit the activity. The inhibiting action of ether in high concentrations is partially reversible. These observations support the hypothesis that the parasympathetic effects observed during general anesthesia from ether and CHCl_3 are not due to inhibition of cholinesterase activity.

L. E. GILSON (Chem. Abstr.).

Cholinesterase and Pseudocholinesterase. Vincent, D., [*Presse med.*, **54**, 571-3 (1946).]

True cholinesterase of the nervous system is effective at a maximum concentration of acetylcholine of 1 mgm. in 100 c.c. The non-specific pseudocholinesterase of the serum and pancreas is most effective at a concentration of 100 mgm. per 100 c.c. Acetyl- β -methylcholine is hydrolyzed by true cholinesterase. Benzoylcholine is split by the pseudocholinesterase.

A. E. MEYER (Chem. Abstr.).

Action of Calcium, Barium and Magnesium on Blood Cholinesterase. Scoz, G., and Michele, G. De (Univ. Naples). [*Boll. soc. ital. biol. sper.*, **19**, 24 (1944).]

In Na barbital buffer solution of pH 8 low concentrations of Ca^{++} , Ba^{++} and Mg^{++} increased and high concentrations inhibited the cholinesterase activity of whole blood. Removal of Ca^{++} from blood (by oxalate) inhibits the cholinesterase activity.

L. E. GILSON (Chem. Abstr.).

Anaphylaxis and Cholinesterase Activity. Laborit, H., and Morand, P. [*Press med.*, **54**, 533-4 (1946).]

It is claimed that anaphylactic shock is caused by acetylcholine, and seems to be determined by a deficiency in cholinesterase.

A. E. MEYER (Chem. Abstr.).

The Significance of Serum Cholinesterase. Cristol, P., Passouant, P., Benezech, C., and Dularte, G. [*Presse méd.*, **54**, 557-8 (1946).]

The level of serum cholinesterase is low in uncompensated cirrhosis of the liver, jaundice, active pulmonary tuberculosis, nephritis with edema, and insulin-treated diabetes. It is normal or increased in jaundice caused by biliary obstruction, in inactive tuberculosis, untreated diabetes, and in hypertension.

A. E. MEYER (Chem. Abstr.).

Cholinesterase Determinations. Aron, Émile, and Herschberg, A. D. [*Presse med.*, **54**, 107-8 (1946).]

The determination of cholinesterase does not seem to be of value as a means of differential diagnosis. The cholinesterase is high wherever the acetylcholine activity is increased. Therefore it is high in asthma, spastic constipation, and similar conditions of high parasympathetic tonus. The determination has mainly a prognostic value.

A. E. MEYER (Chem. Abstr.).

A New Biological Test: The Determination of Cholinesterase Activity and Its Clinical Importance. Laborit, H., and Morand, P. [*Presse méd.*, **54**, 106-7 (1946).]

The determination is of interest in angina and coronary disease, Raynaud's disease, megacolon, gastric ulcer, insulin-resistant diabetes, bronchial dilatations, and vascular affections of the retina. In asthma hypoactivity of cholinesterase is observed.

A. E. MEYER (Chem. Abstr.).

Protection of Cholinesterase Against Irreversible Inactivation by Diisopropyl Fluorophosphate in vitro. Koelle, Geo. B. (Edgewood Arsenal, Md.) [*J. Pharmacol.*, **88**, 232-7 (1946).]

Eserine, by combining reversibly with rat brain cholinesterase, protects the enzyme against irreversible inactivation by diisopropyl fluorophosphate (DFP) *in vitro*. The degree of protection varies directly with the concentration of eserine. This may explain how eserine protects cats against DFP poisoning. Of 19 other anticholinesterase drugs similarly tested, prostigmine and carbamylcholine afforded marked protection; pilocarpine, nicotine, atropine, choline, procaine and morphine afforded relatively slight protection; and methylene blue, strychnine, atebirin, quinine, NaF, thiamine, cysteine, Na p-amino-benzoate, acetyl- β -methylcholine, acetylcholine and curare (intocostin) gave no protection. The protective property does not appear to depend on the potency of anticholinesterase activity alone, but also on the ability of the compound to compete with DFP for a specific active group of the cholinesterase molecule.

L. E. GILSON (Chem. Abstr.).

Action of Atropine on Blood Cholinesterase. Scoz, G., and Michele, G. De (Univ. Naples). [Boll. soc. ital. biol. sper., **19**, 5-6 (1944).]

Very small quantities of atropine increased the cholinesterase activity of blood *in vitro*. In normal human subjects the subcutaneous injection of 1 mgm. of atropine sulfate increased the cholinesterase activity of the blood 30-50 per cent. for several hours.

L. E. GILSON (Chem. Abstr.).

Ultraviolet Spectrophotometric Studies on Cerebrospinal Fluids. Spiegel-Adolf, Mona, and Wycis, H. T. (Temple Univ. Med. School, Philadelphia). [J. Phys. Chem., **50**, 447-52 (1946).]

Either a Hilger quartz spectrograph and sector-photometer or a D U Beckman photoelectric quartz spectrophotometer were employed to measure the extinction coefficients of cerebrospinal fluids in the wave-length range 220 m μ to 300 m μ . The results showed a marked selective absorption, with a peak at 265 m μ in cerebrospinal fluids of patients who had sustained a cerebral concussion or been subjected to convulsive disorders. The selective absorption of these fluids has been tentatively explained by the presence of nucleic acids or their derivatives, liberated by cell injury. A comparison of the selective absorption of cerebrospinal fluids with that of pure sodium thymonucleate indicates the presence of an average of 0.1 mgm. of nucleic acid per molecule in the pathological cases.

W. F. MEGGERS (Chem. Abstr.).

Influence of Thiamine on the Nicotinic Acid Content of Cerebrospinal Fluid. Malaguzzi-Valeri, Claudio, and Neri, Ferrante (Univ. Bari, Italy). [Boll. soc. ital. biol. sper., **17**, 644-5 (1942).]

In 4 normal subjects the spinal fluid contained 15-19 γ /c.c. of nicotinic acid. Parenteral administration of 100 mgm. of nicotinic acid daily for several days approximately doubled the values; 100 mgm. of nicotinic acid plus 12.5 mgm. of thiamine daily for the same period caused a decrease in spinal-fluid nicotinic acid to an average of 10 γ /c.c.

L. E. GILSON (Chem. Abstr.).

The Copper Content of the Cerebrospinal Fluid. Axtrup-Lund, S. (Univ. Lund). [Ann. Paediat., **166**, 259-64 (1946).]

The Cu content of cerebrospinal fluid (measured by the method of Heilmeyer, Fischer's Verlag, Jena, 1941) in various diseases averaged 15 γ per cent. with a range of 1 to 26 γ per cent. In cases of meningeal affection the Cu content is low.

BARBARA R. MURRAY (Chem. Abstr.).

2. Pharmacology and Treatment.

Conditioned Reflex Treatment for Alcohol Addicts. [Clin. Med., **53**, 220-2 (1946).]

Modern Trends in the Treatment of Alcohol Addicts. [J. soc. Casework, **27**, 222-9 (1946).]

R. D. WEITZ (Psychol. Abstr.).

Fixation of Arsenic in the Central Nervous System During Hyperpyrexia. Untersteiner-Occhialini, L. (Univ. Genova, Italy). [Boll. soc. ital. biol. sper., **18**, 197-8 (1943).]

Active hyperthermia was induced in rabbits by injection of a mixture of several species of killed bacteria, or passive hyperthermia was produced by placing the rabbits in a hot chamber; then a solution of arsenite or neoarsphenamine was injected. In no case was there any significant fixation of arsenic by the brain or medulla.

L. E. GILSON (Chem. Abstr.).

Penicillin in the Treatment of Neurosyphilis. I. Asymptomatic Neurosyphilis. Moore, Joseph E., and Mohr, Charles F. (Johns Hopkins Univ., Baltimore). [Am. J. Syphilis, Gonorrhoea, Venereal Diseases, **30**, 405-19 (1946).]

Intramuscular injection of penicillin has a favorable influence on spinal fluid abnormalities and affects, in order, cell count, protein content, colloidal gold curve, and Wassermann reaction. The rapidity and extent of its action depends in the

degree of the spinal fluid abnormality and the duration of the syphilitic infection. The penicillin was administered over a period of 7-10 days. Five of 48 patients with early, and 19 of 41 patients with late, asymptomatic neurosyphilis had abnormally high protein, greater than 38 mgm. per cent., in the cerebrospinal fluid. The protein content fell after treatment and attained a normal value by the sixth month.

A. DIETZ (Chem. Abstr.).

Electrical Manifestations of the Cerebellum and Cerebral Cortex Following DDT Administration in Cats and Monkeys. Crescitelli, Frederick, and Gilman, Alfred (Edgewood Arsenal, Md.). [*Am. J. Physiol.*, **147**, 127-37 (1946).]

The alterations in the spontaneous electric potentials recorded from either the exposed or non-exposed cerebral cortex and cerebellum, following the intravenous administration of DDT emulsions into cats and monkeys which had been treated with small doses of Na pentobarbital to suppress the convulsive action of DDT, are presented.

E. D. WALTER (Chem. Abstr.).

Action of Magnesium on the Excitability of Nerves and Muscles. Bartorelli, Cesare (R. Univ. Bologna). [*Arch. fisiol.*, **42**, 316-51 (1942); cf. *C. A.*, **40**, 5833⁵].

Muscle preparations, the gastrocnemius muscle of *R. temporaria* and *R. esculenta*, showed shortening of the chronaxia and increase of the rheobase, while nerve preparations showed lengthening of the chronaxia and a similar increase in rheobase.

H. L. WILLIAMS (Chem. Abstr.).

Convulsant Action of Pyridoxine. Saviano, Mario (R. Univ. Napoli). [*Arch. fisiol.*, **42**, 375-83 (1942).]

H. L. WILLIAMS (Chem. Abstr.).

Change in Neuromuscular Excitability Caused by Quaternary Ammonium Salts. Bartorelli, Cesare (R. Univ. Bologna). [*Arch. fisiol.*, **42**, 189-221 (1942).]

Gastrocnemius nerve-muscle preparations from *R. temporaria* and *R. esculenta* were made more sensitive by the iodides of tetramethylammonium, tetrapropylammonium and tetrabutylammonium, while tetraethylammonium iodide caused an initial diminution in sensitivity followed by an increase.

H. L. WILLIAMS (Chem. Abstr.).

Effects of Several Local Anesthetics on the Resting Potential of Isolated Frog Nerve. Bennett, A. L., and Chinburg, K. G. (Univ. of Nebraska Med. Coll., Omaha). [*J. Pharmacol.*, **88**, 72-81, (1946).]

By a study of resting and demarcation potentials in isolated frog sciatic nerves it was shown that cocaine, procaine, intracaine, borocaine, monocaine, pontocaine, metycaine, nupercaine, naphthacaine, γ -phenyl- γ -hydroxy- β -(diethylamino)propyl benzoate, β -diethylaminoethyl-trans- α -ethylcinnamate, β -(N-methyl-N-phen-ethyl amino) ethyl carbanilate, and γ -di-ethylaminopropylphenylurethan block conduction without depolarizing the nerves. This supports the view that anesthetics in general block nerves because they stabilize those conditions, relative to the cell membrane, which normally are sufficiently labile to permit the phasic shift in potential during impulse conduction.

L. E. GILSON (Chem. Abstr.).

The Synergism Between the Barbiturates and Ethanol. Ramsey, Helen, and Haag, H. B. (Med. Coll. of Virginia, Richmond). [*J. Pharmacol.*, **88**, 313-22 (1946).]

The administration of EtOH markedly increases the anesthetic and toxic actions of Na seconal (Na allyl-sec-amylbarbiturate), Na phenobarbital, and Na barbital given orally to mice and Na pentothal given to dogs. The disposition of EtOH in the body appeared not to be influenced by the presence of Na barbital; conversely, the blood level of picrotoxin was less efficient as an analeptic in rabbits given Na pentobarbital plus EtOH than in those given Na pentobarbital only.

L. E. GILSON (Chem. Abstr.).

Comparative Study of Several Barbiturates with Observations on Irreversible Neurological Disturbances. Krop, Stephen, and Gold, Harry (Cornell Univ. Med. Coll., New York, N.Y.). [*J. Pharmacol.*, **88**, 260-7 (1946).]

Cats show very large individual variations, but the approximate oral LD 50 is, for seconal (allyl-sec-amylbarbituric acid), 50 mgm./kgm.; pentobarbital, 100;

sigmodal (sec-amyl- β -bromoallylbarbituric acid and antipyrine), 110; and per-noston (sec-butyl- β -bromoallylbarbituric acid), 135 mgm./kgm. The course of action after oral administration of the above dosage in cats is, onset of ataxia in about 5 minutes, maximum narcosis in about 30 minutes, duration of full effect for about 18 hours and, if not fatal, disappearance of ataxia after 2-3 days. With phenobarbital (LD 50 = 175 mgm./kgm.) the onset of ataxia is somewhat slower and the ataxia lasts 2-3 times as long. Large doses of sigmodal cause irreversible damage of the central nervous system, resulting in motor, postural and reflex abnormalities in about 8 per cent. of cats, but not in dogs. Large doses of per-noston also sometimes damage the central nervous system of cats. Such action does not occur with compounds not containing the bromoallyl group.

L. E. GILSON (Chem. Abstr.).

Narcosis and Precipitation of Cellular Lipides. Dode, Maurice, Gavaudan, Pierre, and Poussel, Helene. [Compt. rend., **223**, 521-3 (1946).]

A theory of narcosis based on precipitation under the action of narcotic is compatible with the principles of thermodynamics. It is necessary to determine the nature of the precipitation, whether it is truly a precipitation of the lipides of the lipoprotein complexes.

RACHEL BROWN (Chem. Abstr.).

Action of Wine on Vestibular Chronaxia. Mouriquand, G., and Coisnard, J. [Compt. rend. soc. biol., **140**, 294-5 (1946); cf. C. A., **40**, 6656¹.]

In human subjects the ingestion of 60-100 c.c. of red wine (9 per cent. EtOH) caused a small increase in vestibular chronaxia; 200-500 c.c. caused a small decrease.

Action of Ingested Insulin on Vestibular Chronaxia. [Ibid., 296-7.]

In men, children, and pigeons, the oral or parenteral administration of insulin caused an important decrease in vestibular chronaxia.

L. E. GILSON (Chem. Abstr.).

Metrazole Epilepsy and the Physiological Basis of Convulsant Coma Therapy. Chauchard, Paul, Mazoué, Henriette, and Lecoq, Raoul (Hôpital de St-Germain-en-Laye). [Ann. pharm. franç., **3**, 143-9 (1945).]

A discussion of results previously obtained by Chauchard *et al.* and others (cf. C. A., **39**, 1642³), from which various conclusions are drawn. It is thought that the electroencephalographic manifestations induced by metrazole are not due to a cerebral excitation, but to the repercussion of the excitation of the lower nerve centers on the brain. The resultant bursts of motor nerve impulses are thought to overcome the normal barrier between the cortex and the periphery. For the same reasons as insulin and electric shock, metrazole induces coma by depressing the brain and exciting the lower centers. From a therapeutic standpoint it would be inaccurate to consider this either as a pure convulsive or a pure coma-producing agent. Simple hypnotics or anesthetics do not possess the same properties. Chronaxic measurements show that convulsive coma therapies cause complex changes in the nervous system, which apparently are responsible for their greater effectiveness. The brain is not only subjected to a depressing influence; according to the observation of I. Bertrand *et al.* (Compt. rend. soc. biol., **138**, 143 (1944)) it is affected by the repercussions of the mechanism of the excitation of the lower centers.

A. PAPINEAU-COUTURE (Chem. Abstr.).

Tetrazole Derivatives. III. Some Pharmacologic Properties of Aminotetrazoles. Gross, E. G., and Featherstone, R. M. (State Univ. of Iowa, Iowa City). [J. Pharmacol., **88**, 353-8 (1946); cf. C. A., **40**, 6656⁴.]

The stimulating and analeptic actions of the HCl salts were studied in rats, and the lethal doses were also determined. Most of them produced convulsions and depressed respiration. The lack of analeptic action is ascribed to the presence of the amino group. The optimum structural factors for central nervous stimulation appear to be the presence of a relatively large alkyl or phenalkyl group in the I position and a small group on the 5-amino group. The unsubstituted amino compound of the series, TT-31, showed no central nervous action, either stimulatory or depressant.

L. E. GILSON (Chem. Abstr.).

Tridione: A New Anticonvulsant Drug. Richards, R. K., and Everett, G. M. (Abbott Labs., Chicago). [*J. Lab. Clin. Med.*, **31**, 1330-6 (1946); cf. C. A., **41**, 212g.]

A discussion of the pharmacology and therapeutic applications of tridione (3,5,5-trimethyloxazolidine-2,4-dione). Clinical investigations indicate its usefulness in the treatment of *petit mal* epilepsy, although its site of action has not yet been determined. J. P. CRISPELL (Chem. Abstr.).

The Excretion of Amphetamine. Harris, S. C., Searle, L. M., and Ivy, A. C. (Northwestern Univ. Med. School, Chicago). [*J. Pharmacol.*, **89**, 92-6 (1947).]

When 30 mgm. of dl-amphetamine (benzedrine) or 15 mgm. of d-amphetamine (dexedrine) was given daily to 10 human subjects for 56 days, the daily urinary excretion of the drug remained essentially constant. The average recovery in the urine was 45.6 per cent. for benzedrine and 47.3 per cent. for dexedrine. These results imply that the rate of destruction (presumably in the liver) remained constant, and that the development of tolerance cannot be attributed to a progressive increase in drug destruction. There was no evidence of a diuretic effect of amphetamine; the excretion of the drug was independent of urinary volume. Amphetamine did not affect the blood level of ascorbic acid.

L. E. GILSON (Chem. Abstr.).

Procaine Therapy. Velazquez, B. Lorenzo. [*Farmacoterap. actual* (Madrid), **3**, 655-69 (1946).]

The total pharmacology of procaine is discussed, and kymographic tracings are presented to demonstrate, in comparison with p-aminobenzoic acid and diethylaminoethanol, the inhibiting effect on the guinea-pig intestine, the antagonism to the spastic action of acetylcholine, the stimulation of the uterus, especially the enhancing effect on pituitrin, and also the increase of the pressor action of the latter in the spinal cat. The anticholinesterase action is demonstrated in experiments with the leech muscle. Various methods of local anesthesia and nerve blocking are discussed.

A. E. MEYER (Chem. Abstr.).

Paralysis by Curare. Zelikowski-Guttel, A. (Sorbonne, Paris). [*Compt. rend. soc. biol.*, **140**, 451-2 (1946).]

The effects of several kinds of curare were studied in frogs. There was very little difference in the actions of orthocurare and paracurare. The paralysis produced appeared to be due to action on the central nervous system rather than to peripheral interference with transmission from nerve to muscle.

L. E. GILSON (Chem. Abstr.).

Effects of Ether and Curare on Neuromuscular Transmission. Schallek, Wm. (Washington Univ. Med. School, St. Louis, Mo.). [*Proc. Soc. Exptl. Biol. Med.*, **63**, 78-81 (1946).]

The response of the gastrocnemius to maximum stimulation through its nerve was studied in rats. During deep etherization there is a depression of 12 per cent. in the muscle-action potential. At the same time the respiration is depressed; anoxia alone due to this may account for 5 per cent. depression. Hence a muscular depression of only 7 per cent. can be attributed to the action of ether, not necessarily involving neuromuscular block. A synergism exists between ether and curare (intocostarin), since the effect of these agents given together is one-third greater than the sum of their separate effects.

L. E. GILSON (Chem. Abstr.).

Effect of Pentothal Anesthesia on Canine Cerebral Cortex. Homburger, E., Himwich, W. A., Etsen, B., York, G., Maresca, R., and Himwich, H. E. (Union Univ., Albany, N.Y.). [*Am. J. Physiol.*, **147**, 343-5 (1946).]

The effect of light pentothal narcosis was compared with that of deep anesthesia, and the av. O intake in the brain of 7 dogs was found to fall from 5.9 c.c. O per dog per 100 gm. of tissue per min. to 2.6 c.c. O. per 100 gm. of tissue per min., a decrease of 56 per cent. The cerebral metabolic rate is higher than that obtained from the brain of man and monkey with the same methods. The difference is laid to the fact that in the dogs the venous blood came chiefly from the cerebral hemispheres, which possess a faster metabolism than the lower parts of the brain.

E. D. WALTER (Chem. Abstr.).